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# THE VEGETATION OF PETÉN

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With an Appendix

Studies of Mexican and Central American Plants—I

BY

CYRUS LONGWORTH LUNDELL

*University of Michigan*



PUBLISHED BY CARNEGIE INSTITUTION OF WASHINGTON

WASHINGTON, D. C.

1937





















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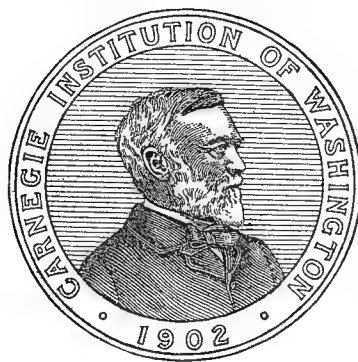
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Map of the Department of Petén, Guatemala, showing phytogeographical divisions and collection localities.

#### PLATE 2

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#### PLATE 5

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FIG. 2—*Milpa* clearing in secondary forest near San Andres in Northern Petén. Area had been burned over and was ready for planting. Photographed by L. C. Stuart.

#### PLATE 6

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#### PLATE 7

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## PLATE 9

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(In pocket inside back cover)

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## PLATE 11

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(In pocket inside back cover)

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## PLATE 17

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## PLATE 18

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## PLATE 19

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## PLATE 20

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FIG. 2—Sabana Tzimintun. Photograph was taken a few days after fire had swept the area. Stone foundation is reputed to be remains of structure in which an image of the horse of Cortes was hewn.

## PLATE 21

Sabana Kantetul. The xerophytic marginal vegetation has overrun greater part of the savanna. This is the first stage in transition from grassland to mesophytic forest.

## PLATE 22

FIG. 1—The black fire-swept grassland. Within a few days after the first rains, the perennial herbs sprout out and begin to flower, changing charred countryside into a garden.

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## PLATE 23

FIG. 1—A hill with much of the forest killed by fire.

FIG. 2—A denuded hill.

## PLATE 24

The savanna northwest of La Libertad. Such low ranges of forested limestone hills separate broad expanses of grasslands.

## PLATE 25

FIG. 1—Sabana Kaltó.

FIG. 2—Sabana Kaltó. Note broad expanses of flatlands, and numerous "wooded islands" (*zúkches*) which mark locations of sinkholes.

## PLATE 26

(In pocket inside back cover)

Diagrammatic cross-section through the Central Petén Savanna Country, showing topography and zonation of the vegetation.

## PLATE 27

FIG. 1—A grove of the *saha* tree, *Curatella americana*.

FIG. 2—Scattered individuals of *Byrsonima crassifolia*, the *nanze* tree. The *saha* and *nanze* are typical small gnarled, fire-resistant savanna trees. Note that fires have burned off all the herbaceous vegetation.

## PLATE 28

FIG. 1—A "wooded island" in Sabana Kaltó. Tree on left with white trunk and large leaves is *Miconia argentea*; tree on right is *Bursera simaruba*.

FIG. 2—A drained sinkhole (*zúkche*) in Sabana Kaltó. The palm is *Acrocomia mexicana*. Photographed by L. C. Stuart.

## PLATE 29

FIG. 1—*Crescentia cujete*, the *calabaza* tree.

FIG. 2—*Crescentia cujete*. The globose fruits are dried and made into useful vessels such as cups, bowls, and dippers.

## PLATE 30

Swampy grassland (*bobolar*) in Sabana Zotz. *Hymenocallis littoralis* is the attractive plant in the foreground.

## PLATE 31

FIG. 1—Street in La Libertad. Note thatched huts and yards enclosed by pole fences. The two medium-sized trees in foreground are *Chrysophyllum cainito* and *Talisia olivæformis*, both planted for fruit. The palm is *Cocos nucifera*, the coconut.

FIG. 2—View of the plaza of La Libertad. A total of 243 species of cultivated, semi-cultivated, adventive, and native plants were collected within the confines of the village. Large tree with partially defoliated crown is *Lucuma hypoglauca*, planted for shade and fruit.

## PLATE 32

FIG. 1—Sabana Kaltó.

FIG. 2—A small "wooded island" (*zúkche*) surrounding a drained sinkhole. A total of 59 species of ferns and phanerogams were found here. Tall slender tree with an umbrella-like crown is *Xylopia frutescens*.

## PLATE 33

FIG. 1—Aguada Chachacluum. This shallow sinkhole dried out in 1933, and its basin was overrun by herbs of which *Eragrostis hypnoides* was most prominent. In the background the nature of the *aguada* bank vegetation is evident. The low shrubby belt at the edge is followed inland by a tree belt which intergrades into the flatland high forest.

FIG. 2—Aguada Polol, a large basin in the open savanna. Polol, the ancient Maya ceremonial center, lies hidden in the forest in the background.

## PLATE 34

Aguada Yaxnic in Monte Chicbul. This shallow undrained sinkhole retained water through the dry season of 1933. Continual disturbances by cattle prevent the growth of aquatic vegetation. The bush in the background is marginal forest bordering the savanna.

## PLATE 35

Flatland forest surrounding Aguada Chachacluum. Forest vegetation is slowly invading the grasslands in spite of fire conditions and severe dry season. Note abruptness of change from grassland to forest. The tall white trees in the center with few branches are *Didymopanax morototoni*.

## PLATE 36

Marginal forest surrounding a drained sinkhole in the flatlands. Note thorny, scrubby, semi-deciduous xerophytic vegetation. The giant terrestrial monocotyledon in center is *Bromelia karatas*. Among other species are the *supa* palm, *Acrocomia mexicana*, a bullhorn *Acacia*, and two lianas, *Davilla kunthii* and *Tetracera volubilis*.

## PLATE 37

The savanna near Chiche. Note the densely forested limestone hill in the background.

## PLATE 38

FIG. 1—The limestone valley forest in Monte Hiltun. The giant tree is *Enterolobium cyclocarpum*, and the thorny slender palm is the *escoba*, *Cryosophila argentea*. Fire had swept through the area and cleared out practically all the underwood.

FIG. 2—A section of the limestone valley forest of Monte Hiltun showing fire destruction. Many of the trees burned to hollow shells and collapsed.

## PLATE 39

The Subin River near Santa Teresa. The floating hydrophyte, *Eichhornia crassipes*, almost blocks the stream. Vine which completely covers the river bank trees is *Vigna repens*.

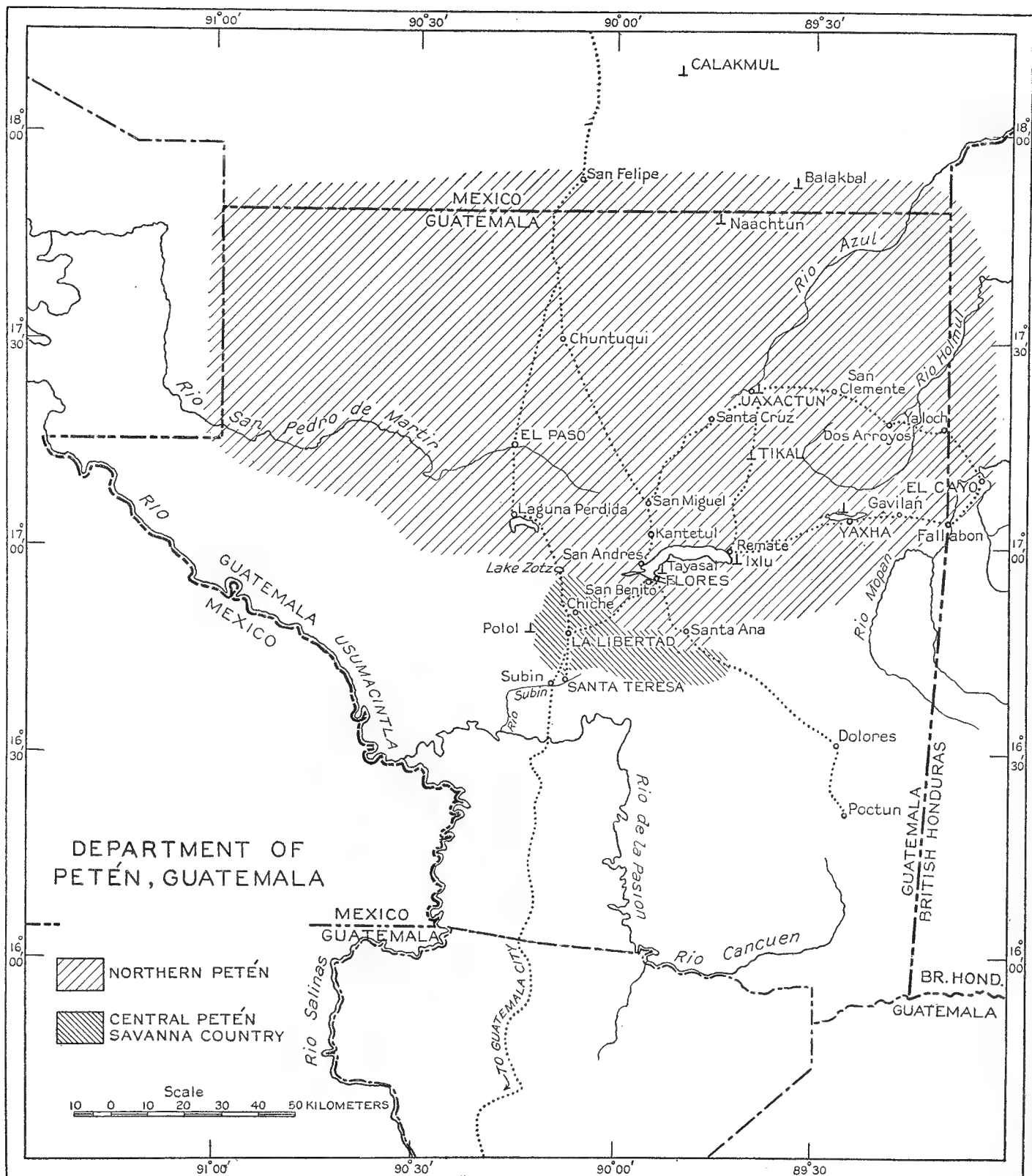
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Map of the Department of Petén, Guatemala, showing phytogeographical divisions and collection localities.

# THE VEGETATION OF PETÉN<sup>1</sup>

## INTRODUCTION

### BOTANICAL EXPLORATION

So little biological exploration has been undertaken in the Department of Petén, Guatemala, that the area has remained one of the most fertile fields for investigation. In 1922 Mr. O. F. Cook and Mr. R. D. Martin on their visit to British Honduras and Petén collected 234 numbers of plants, the greater part of which were obtained in Northern Petén. This was the first botanical collection made in the region. The material represented numerous interesting plants, outstanding among which was the palm, *Opsiandra maya*, described as a new genus and species (Cook, 1923). Through the courtesy of Mr. Cook, who kindly furnished the data, practically all the species obtained in Petén in 1922 are included in the annotated list (p. 49).

A more extensive collection was obtained by Professor H. H. Bartlett in the vicinity of Uaxactun where the 1931 biological expedition of the Carnegie Institution of Washington and the University of Michigan to the Maya area established its headquarters (Bartlett, 1932). An excellent illustrated report on the vegetation of that area was published recently (Bartlett, 1935b). With his permission, I have included in the annotated list (p. 49) records of practically all the species obtained in 1931 and such field data as vernacular names, habitats, notes on physiognomy, etc.

While stationed at Tuxpeña in Southern Campeche, the writer collected a few specimens in January 1932 on an exploratory trip to the ruins of Naachtun (Nohoxna) which lie near the border of Guatemala and within the Northern Petén phytogeographical division (Lundell, 1933a). In March and April 1932 on the trip from Tuxpeña, Campeche, into Petén, and subsequently, while connected with the Chicle Development Company at El Paso on the San Pedro de Martir River, I undertook ecological studies and collected 215 numbers of ferns and phanerogams in northwestern Petén.

The greater part of the data and collections on which this publication is based were obtained by the writer as botanist and director of the 1933 Carnegie-Michigan expedition. Although studies were undertaken in British Honduras by the expedition, the work was concentrated in the Department of Petén. Headquarters were established at La Libertad in the savanna country from March to June. Notes and collections made along the Fallabon-Lake Petén trail, when entering and leaving Petén, supplemented similar cross-section studies of the vegetation made along the same route and in northwestern Petén from San Felipe, Campeche, to El Paso in 1932. From our base, trips of exploration extended northward to Lake Zotz, Lake Petén, and Kantetul. Collecting trips into southern Petén covered

<sup>1</sup> The manuscript of this book was cited by Bartlett (1935b, p. 25) under the title of *Botanical Studies in the Department of Petén, Guatemala*.

an area along the Subin River in the vicinity of the Santa Teresa *rancho* of Mr. O. A. Taintor. Polol and Lake Zotz were the westernmost localities visited in 1933. All localities are indicated on the map (Plate 1, facing p. 1).

Since returning from the 1933 field trip, the writer has maintained Mr. Mercedes Aguilar H. as a resident collector in central Petén, and this paper takes into account all of his collections through 1935. In 1934 Mr. W. A. Schipp collected along the border between British Honduras and Guatemala, and his collections there may be considered as representing part of the flora of southern Petén.

The present report has been preceded by four briefer papers (Lundell, 1933d, 1934a, 1934b, 1935) and by publications of others who have cited some of the collections (Bartlett, 1935a, 1935b, 1935c, 1935d; Swallen, 1936; Morton, 1936a, 1936b; Standley, 1935; Mains, 1935; Steere, 1935; Hedrick, 1935; Woodson, 1934; Leonard, 1936; Killip, 1936; and Killip and Morton, 1936).

Although the extensive collections around Uaxactun and La Libertad and the smaller scattered collections in other localities have made available a considerable amount of botanical material, probably less than half of the flora of northern and central Petén is now known. Excepting the borderlands, southern Petén is entirely unexplored botanically. It is to be hoped that exploration of this highly important archæological area, so interesting from the botanical side of the problem, can proceed until we have an adequate knowledge of the flora of the entire Department.

The studies so far undertaken must all be considered preliminary and subject to elaboration by more exhaustive surveys.

#### ACKNOWLEDGMENTS

During the 1932 and 1933 seasons, the writer collected 3472 numbers of plants in the Department of Petén, Guatemala, and northern British Honduras. These collections have been supplemented by three resident collectors: Mr. Mercedes Aguilar H. in Petén, and Mr. Percy H. Gentle and Mr. Mercedes Chanek in British Honduras, who combined have added approximately 2200 numbers from 1933 to 1936.<sup>1</sup>

Although the reports on part of this material will appear in other publications, the writer wishes to take the opportunity now to acknowledge his indebtedness to the following persons for studying the collections: Dr. W. R. Maxon, Pteridophyta; Professor H. H. Bartlett, Palmæ; Mr. E. P. Killip, Passifloraceæ; Mr. C. V. Morton, Malpighiaceæ and Dioscoreaceæ; Mr. Killip and Mr. Morton, Smilacaceæ; Mr. E. C. Leonard, Acanthaceæ; Dr. S. F. Blake, Compositæ and Polygalaceæ; Professor Oakes Ames and Mr. Charles Schweinfurth, Orchidaceæ; Dr. B. L. Robinson, Eupatoreæ; Dr. Lyman B. Smith, Bromeliaceæ; Dr. I. M. Johnston, Boraginaceæ; Dr. William Trelease, Piperaceæ and *Phoradendron*; Dr. Carl Epling, Labiatæ; Dr. A. S. Hitchcock and Mr. Jason R. Swallen, Gramineæ; Dr. Hugh O'Neill, Cyperaceæ; Dr. R. E. Woodson jr., Apocynaceæ and Asclepiadaceæ; Dr. E. E. Sherff, *Bidens*; and Dr. H. A. Gleason, Melastomataceæ. A few of the

<sup>1</sup> A complete set of these collections and all other specimens cited in this publication are on file in the Herbarium of the University of Michigan unless otherwise indicated.

commoner plants were identified by the author. The remainder of the collection, the greater part, was named by Dr. P. C. Standley, to whom the writer expresses his special thanks.

To Dr. John C. Merriam, President of the Carnegie Institution of Washington, and Dr. A. V. Kidder, Chairman of the Division of Historical Research, the writer is greatly indebted not only for making the expedition possible, but for their support of the subsequent studies. Professor H. H. Bartlett, Chairman of the Department of Botany, Dr. E. B. Mains, Director of the Herbarium, Mr. F. M. Gaige, Director of the Museum of Zoology, and Dr. J. H. Ehlers, of the University of Michigan, have backed the work whole-heartedly, for which I express my sincere appreciation.

To my companion on the expedition, Dr. L. C. Stuart of the University of Michigan, I make grateful acknowledgment for aid in studying the region. Much credit for the success of the field work was due to the cooperation of Mr. O. A. Taintor of La Libertad, Mr. Ruben Alvarado of Flores, and Mr. C. E. Hopun of El Cayo, British Honduras, and the Chicle Development Company of New York.

Mr. Oliver P. Ricketson jr. of the Carnegie Institution of Washington obtained many courtesies for us from the government officials of Guatemala. Since 1933 he has very kindly facilitated the handling of Mr. Aguilar's collections.

To my wife, Amelia A. Lundell, I make grateful acknowledgment for her generous aid in labeling the collections.

#### MAJOR GEOGRAPHICAL FEATURES OF THE REGION

The Department of Petén, the northernmost province of Guatemala, covers an estimated area of 40,000 square kilometers between 16° and 17° 90' north latitude and 89° 25' and 91° west longitude. It is relatively isolated, being cut off on the southeast, south, and southwest by the Maya, Alta Vera Paz, and Chiapas Mountains. As Sapper (1898) states, it belongs orographically and geologically to the Yucatan Peninsula, a karst-like limestone region which has become attached to Central America in comparatively recent times.

That portion of Petén lying north of Lake Petén belongs to the south-central plateau of the peninsula, a dissected tableland with a maximum elevation of about 400 meters. The central area between Lake Petén and the Subin River is covered with beds of supposedly Cretaceous limestone. Southern Petén is a great, fairly flat, subsidence basin. Except for the Cretaceous area, the deposits of the region are all believed to be Tertiary.

The Department, except the savanna areas, is covered with luxuriant forest. The savanna country, as delimited in the map (Plate 1), is of local extent comprising only a comparatively small area. In the vicinity of Poctun in southeastern Petén there exist, according to local reports, considerable areas of pine. Except for these, the forest is entirely broad-leaved and mostly evergreen.

The population of the region is centered around Lake Petén where Flores, the government seat, is located on an island (Plate 2). Scattered through central Petén are a number of villages. However, as a whole the area is sparsely popu-



lated. North of Lake Petén and south of the Rio Pasion, the country is practically uninhabited.

The people are chiefly agriculturists, although many obtain employment in the chicle industry. The important farm products are maize, beans, pumpkins, and fruits, all of which are used locally. Some sugarcane is grown, but not enough to meet local demands. Much foodstuff is imported.

Cattle thrive in the savanna country, but because of inaccessibility to outside markets cattle raising has not been profitable.

Modern roads are entirely lacking. Only narrow trails lead to the exterior, and over these mule-trains have borne the commerce of Petén. Water transportation is limited, being confined chiefly to the Usumacintla River and its tributaries. The recent establishment of regular air service between Flores, Guatemala City, and Puerto Barrios has been a boon to the region.

The great wealth of the Department lies in its forest products—chicle and mahogany primarily. Northern Petén contains the richest sapodilla forest in the world, and its continued exploitation has been one of the sources of the wealth of Guatemala. Formerly a considerable amount of mahogany was logged along the Usumacintla River and its tributaries. The stands of mahogany are very extensive and await future exploitation. The forest contains other valuable timbers and forest products.

The southern limit of the upland climax formation of the Yucatan Peninsula, characterized by the sapodilla forest, lies approximately along the east-west line formed by Laguna Perdida, Lake Petén, and Lake Yaxha (Lundell, 1933b). This tableland area, lying chiefly within Guatemala, comprises a phytogeographical division which I have designated as Northern Petén (Plate 1).

The savanna country of central Petén, with its secondary vegetation, has boundaries which apparently correspond closely to the eastern extension of the Cretaceous deposits. I designate this local region as the Central Petén Savanna Country (Plate 1), another minor phytogeographical division of the same degree of distinctness as the others I have recognized in the northern sections of the Yucatan Peninsula (Lundell, 1934b).

The low, slightly undulating subsidence basin of southern Petén is so little known botanically and otherwise that little can be said concerning it. A luxuriant rain-forest in which species of the Sapotaceæ are characteristic appears to cover the greater part of the area.

Northern Petén, the Central Petén Savanna Country, and the borderlands of southern Petén are discussed in the sections of the book which follow.

## NORTHERN PETÉN

Northern Petén, characterized by the most luxuriant phase of the climatic climax formation typified by the sapodilla forest, is confined closely to the political boundaries of the Department of Petén on the north, east, and west, extending on the south to Lake Petén (Plate 1).

## DESCRIPTION OF THE REGION

## GEOLOGY AND TOPOGRAPHY

For statements on the physiography of the region we are indebted to Sapper (1894, 1899) and Sorre (1928). As already noted, Northern Petén is the southernmost part of the dissected Yucatan tableland, a low plateau with a maximum elevation not exceeding 400 meters.

Limestones covering the Petén area are all believed to be Tertiary. The strata were laid down after the mountains of Chiapas, Alta Vera Paz, and southern British Honduras were formed, and therefore do not share in the disturbances of the latter. However, slight folds are evident in Northern Petén as a series of east-west flexures as shown in the cross-section given by Sapper (1899).

The uplands comprise the east-west hills and broad areas of under-drained, slightly undulating country lying along the low ridges. The hills are broadly rounded or somewhat flat topped; gentle slopes predominate, yet cliffs and steep slopes are encountered near the summits of some.

In the uplands numerous sinkholes (dolines), called *aguadas*, exist which apparently have been formed through subterranean erosion. Most of them are small rain-water ponds with clayey impervious bottoms; some have connections with the under-drainage system and hold water for only a few hours. Many are seasonal, drying out during the rainless months. There are other, mostly larger, *aguadas*, depressions dipping below the water-table, that hold water permanently.

Lying between the east-west hills are wide trough-like depressions at the bottoms of which we find lakes, swampy lowlands, and streams. Scores of lakes exist; some, such as Lake Petén and Lake Yaxha, are of considerable size.

The lowlands are flat "subsidence basins" according to Sapper (1899). Cooke (1931) believes that these basins once formed shallow lakes which have been silted by erosion of the uplands until they lie above ground-water level during the rainless period. Their heavy impervious clay soils largely prevent under-drainage. The result of lack of drainage has been the formation of extended swampy areas, known as *bajos* or *akalches*, synonymous terms. Overflows from the swampy basins occur during the rainiest months. Water stands in the *bajos* the greater part of the wet season and may only partially evaporate during the dry season in some years.

## DRAINAGE

The principal streams are the San Pedro de Martir River, and tributaries of the Rio Candalaria and Rio Hondo. Although they penetrate deep into the country, their surface system is limited, away from the main branches, to wet-season *arroyos*. As a result of the solution of the underlying limestone strata, Northern Petén (a karst-like region) has a subterranean drainage system so greatly developed that surface drainage is limited chiefly to flood periods. The rivers, lakes, *aguadas*, and *bajos* are fed by both surface and under-drainage waters. Some basins, including Lake Petén, have small rivers flowing into them.

## CLIMATE

Recently Sapper (1931, 1932) published meteorological records for two stations in Petén, El Paso, with rainfall data for five years and temperature records for three, and La Libertad, with partial records for one year.

Unfortunately Sapper in both publications misplaces the location of the El Paso station. The El Paso agency of the Chicle Development Company of New York, where the meteorological records are taken, is situated on the north bank of the San Pedro de Martir River approximately as I have indicated on the map (Plate 1). Sapper erroneously places the station, which he designates as "El Paso real," on the Rio Pasion.

In order to make the correction, I am including in table 1 all the available rainfall records for the station. Rainfall data recently obtained from the Chicle Development Company extend the records to 10 years 2 months, the period from July 1924 to August 1934.

Northern Petén, which lies between north latitudes  $16^{\circ} 90'$  and  $18^{\circ}$ , is entirely within the tropics. Uniformly high temperatures and seasonal rainfall characterize the climate.

The following temperature statistics, giving the average in  $^{\circ}\text{C}$ . for three years, 1925, 1926, and 1929, are from the El Paso station (Sapper, 1931): Jan.,  $23.6^{\circ}$ ; Feb.,  $20.7^{\circ}$ ; Mar.,  $26.7^{\circ}$ ; Apr.,  $29.5^{\circ}$ ; May,  $28.9^{\circ}$ ; June,  $28.1^{\circ}$ ; July,  $27.2^{\circ}$ ; Aug.,  $27.5^{\circ}$ ; Sept.,  $27.6^{\circ}$ ; Oct.,  $27.5^{\circ}$ ; Nov.,  $25.3^{\circ}$ ; Dec.,  $25.8^{\circ}$ ; Year,  $26.6^{\circ}$ .

February with  $20.7^{\circ}\text{C}$ . has the lowest average for any month, while April with  $29.5^{\circ}\text{C}$ . has the highest. The difference between the averages for the lowest and highest months is  $8.8^{\circ}\text{C}$ . The lowest temperature recorded was  $14.4^{\circ}\text{C}$ . in January and the highest was  $38.9^{\circ}\text{C}$ . in May.

The coldest months are January and February when "northers" sweeping inland from the Gulf of Mexico cross the peninsula. April and May are the hottest months. As temperatures never approach the freezing point, the critical period for the vegetation is reached, not in the cold, but in the hot months just before the rains come, at which time both the drouth and heat reach their maximum intensity.

TABLE 1—*Rainfall Records from the El Paso Station*<sup>1</sup>

Rainfall in mm. from July 1924 to August 1934												
	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	Av.
Jan.....	....	75	38	36	28	30	20	23	89	127	25	49
Feb.....	....	138	3	36	41	61	51	6	30	25	18	41
Mar.....	....	23	8	0	71	3	19	5	109	8	66	31
Apr.....	....	81	28	0	44	1	86	168	28	0	89	53
May.....	....	64	121	147	53	283	302	30	71	493	147	171
June.....	....	296	112	136	208	541	298	201	244	157	168	236
July.....	129	260	75	231	118	222	224	284	218	254	178	199
Aug.....	393	54	237	144	79	175	130	160	185	409	135	191
Sept.....	460	186	231	467	117	253	297	391	201	424	....	303
Oct.....	369	257	246	207	101	442	263	277	351	269	....	278
Nov.....	257	226	170	96	101	168	23	69	53	41	....	121
Dec.....	130	154	50	0	29	190	78	53	130	76	....	89
Total....	(1738 6 mo.)	1814	1319	1500	990	2369	1791	1667	1709	2283	(826 8 mo.)	1762

<sup>1</sup> Rainfall data were obtained from the Chicle Development Company of New York by Dr. George C. Shattuck, through whose courtesy they are included herein.

The average rainfall of Northern Petén, as is shown by the El Paso records, is approximately 1762 mm. (see table 1). In an analysis of the records some interesting points stand out. Rainfall varies greatly from year to year. In 1928 a total of 990 mm. fell, while in 1929 there were 2369 mm., a difference of 1379 mm. between the two years. As Page (1933) points out in discussing the climate of northern Yucatan, there are cycles of wet and dry years. In 1924, 1925, 1929, and 1933 the precipitation was above the average. In 1930, 1931, and 1932 it was normal, yet on the average more than 600 mm. below 1929 and 1933, whereas in 1926, 1927, and 1928 the rainfall was considerably below the mean. From the standpoint of the vegetation, the three successive dry years culminating in the drouth of 1928 were critical years.

The years are clearly divided into two seasons, the dry extending from November into May, and the wet from May through October. The extremely dry months are January, February, March, and April. In March and April 1927, 1929, and 1933 the rainfall was almost nil. For the five months from December 1926 through April 1927 the rainfall was only 71 mm. Although 1928 was the driest year, its evenly distributed precipitation alleviated conditions and lessened the fire hazard.

The records reveal two maxima of rainfall, occurring in June and September.

The effect of the perennial and annual periods of moisture deficiency must be given more attention in future studies on tropical vegetation. Cycles of dry years and occasional extremely dry seasons are of far greater importance in interpreting the vegetation and its distribution than any average of rainfall conditions. Inasmuch as the Köppen system of climatic classification is based on average conditions, many differences may be expected within the tropics between the climatic boundaries and the vegetational boundaries. Biotic and edaphic factors must be given due consideration in determining the natural vegetation boundaries. Artificial and temporary boundaries are now evident in the tropics over great areas as a result of disturbances by man.

In analyzing the vegetation of the Yucatan Peninsula, one finds that a rainfall of 850 to 1250 mm. allows the establishment of a dry forest, whereas regions with a rainfall in excess of 1250 mm. will be covered with what may be termed quasi-rain-forest, such as grows in southwestern Campeche, southeastern Campeche, and northern Petén. The slender strip along the northwest coast of Yucatan where the rainfall is about 500 mm. is a xerophytic thorn-scrub area now almost completely cleared for henequen plantations. The climate of most of the peninsula borders on the savanna-forest transition. The greater part of Northern Yucatan (Lundell, 1934b, fig. 1) is covered with thickets, probably a result of man's influence. Continued rotation from *acahual* to *milpa* for hundreds of years accompanied by fire destruction may account for the vegetation of today. Were it not for the fact that the shallow calcareous soils favor a vigorous growth of non-grasses, the northern region would likely have been reduced to savanna country centuries ago. It is probable that all of the State of Yucatan, excepting possibly the small strip along



the northwest coast, would revert to dry forest of the nature to be encountered now on the eastern coast and in the Southern Campeche phytogeographical division (Lundell, 1934b) if left undisturbed.

Although hurricanes possibly have some influence on the climate of Northern Petén, the area is too far inland to be greatly damaged by these destructive winds. However, local storms often fell strips of the forest. The giant trees stand in very shallow soil on top of the limestone. They have no tap roots, but some have compensating buttresses. Any considerable wind force will topple the forest patriarchs, and when one falls it carries others with it in the same manner that dominoes lined up close together will topple. In 1931 a long strip of the forest between El Paso and Laguna Perdida was felled in this way.

#### SOILS

The soils of Northern Petén have not been surveyed or studied in any detail. In my travels across the region, I have noted some of their major features.

The well-drained soils of the uplands are all immature, being shallow calcareous clays. They belong to a local type designated technically as *rendzina*. On the hills and steeper slopes the soil mantle is generally so thin that it scarcely covers the outcropping limestone. In valleys and on slightly undulating terrain, the depth may be several feet in which case there is a very thin top covering of litter below which lies a gray-black layer of clay. Under this lies a grayish almost black layer in which fragments of limestone become more numerous toward the substratum. Soils of a similar nature on the hills near La Libertad in the savanna country were found by Stuart to be slightly alkaline, the pH value ranging from 7 to 8.

This *rendzina* soil on the well-drained uplands is the most extensive type, covering possibly 60 per cent of Northern Petén. Although in many places it is reduced to accumulations in pockets of the outcropping limestone, nevertheless it supports vigorous calciphile forest growth. The large roots of the trees sprawl out over the limestone penetrating the substrata through cracks. In view of the fact that dry seasons may extend over periods of five months, it is remarkable that forest growth can exist on the hills; yet sapodilla forest, admittedly somewhat xerophytic, is everywhere present in undisturbed sectors. Forest exists where we would expect sparse growth. As already noted, the fact that the limy *rendzina* soils support such a vigorous growth of non-grasses possibly explains why such long-disturbed sectors as Northern Yucatan have not been reduced to savannas.

The shallow reddish-brown soils found in Northern Yucatan and in the small denuded areas of Northern Petén, such as Sabana Kantetul, are chiefly *rendzina* soils which have become reddish through oxidation following loss of organic matter. The fact that the grayish-black forest soils become reddish when the land is cleared and burned over periodically is evidence enough to show unquestionably that *milpa* agriculture, continued over centuries, tends to reduce organic matter in the soil and thereby lessen fertility.

The soils of the poorly drained and undrained lowlands vary considerably. As a whole they may be classed as deep acid clays:

The most extensive lowland soils are those of the *bajos*. Drainage is very poor and for long periods the *bajos* are flooded. The soils are deep, very heavy, compact, sticky, acid clays which crack when dry. The upper layers range from grayish to black to reddish-brown in color. The lower layers are generally light gray to whitish, a typical character of *glei* soils. Their depth has not been determined. The vegetation cover is low, gnarled, xerophytic swamp forest.

Along streams, on lake banks, in mucky bogs, and in the intermediate poorly drained zone lying between the swamps and the well-drained uplands, minor soil types are present, but nothing is known about them.

## HISTORY OF THE VEGETATION

### MAYA OCCUPANCY OF THE REGION

By the beginning of the Christian era the fundamental outlines of the Maya culture were apparent. At that early date the calendar and hieroglyphic system were in existence. After many centuries the Maya had emerged out of the "archaic" horizon, building a new and distinctive civilization. It is probable that much of their early cultural development took place in Northern Petén.

By 8.14.15.0.0<sup>1</sup> (A. D. 73 or 333) their progress became accelerated; unparalleled expansion, cultural dissemination, and city building ensued so that by 9.15.0.0.0 (A. D. 472 or 731) the so-called Old Empire appears to have covered most of the region now included in Guatemala, British Honduras, and the Mexican states of Campeche,<sup>2</sup> Yucatan, Tabasco, and Chiapas. Its influence extended northward and westward into Oaxaca and Veracruz, and far southward into Honduras and other states of Central America. The Great Period of the Maya of the Old Empire began in 9.15.0.0.0 and closed about 10.2.0.0.0 (A. D. 610 or 869) (see Morley, 1915).

For reasons of which we know little, a decline followed. The great cities of the South ceased to exist as cultural centers and were apparently abandoned one by one. No stela has been discovered in an Old Empire site with a date later than 10.3.0.0.0 (A. D. 630 or 889). Whether the various cities were gradually vacated over a considerable period, or abandoned completely at one time, are conjectural matters.

Although conclusive evidence is not at hand, it is supposed that the population in Northern Petén and elsewhere in Petén had declined drastically by A. D. 1000, and most of the land had been abandoned permanently. Scattered settlements probably continued to exist in the area. I see no reasons to back the opinion that the land was utterly forsaken even though the cultural centers shifted elsewhere, chiefly northward. According to Maya chronicles, the Itza tribe returned to the Lake Petén area in the fifteenth century and built Tayasal, the stronghold

<sup>1</sup> I am citing the Maya dates. According to the Spinden correlation, 8.14.15.0.0 would be A. D. 73, whereas by the Goodman-Thompson correlation, the date would be about A. D. 333. The difference between the correlations is about 260 years.

<sup>2</sup> Since this report was written, Quintana Roo has been restored to its previous status. For a short period it was divided between Campeche and Yucatan.

which was not conquered until 1696. Cortes in 1525 and the Spaniards who visited the region after him all report the existence of villages (see Means, 1917).

In Northern Petén, at least in northeastern Petén, there are stone ruins of a city or ceremonial center for every 25 square miles of the uplands, in addition to innumerable scattered house mounds. In view of this fact, it is certain that all or the greater part of the forest was felled in one period or another during the occupation of the sites.

In considering the vegetation, three points stand out: (1) that the greater part of the upland forest of the area was felled for agricultural purposes; (2) that the population probably had sufficiently declined by A. D. 1000 so that the greater part of the area was permanently abandoned; and (3) that scattered settlements probably have been present since the time of the Old Empire.

The most important fact is that the greater part of the region has been completely abandoned during the past 800 or 900 years, during which interval the climatic climax forest has had time to develop.

#### INTERPRETATION OF DISTRIBUTION OF CERTAIN SPECIES ON BASIS OF MAYA INFLUENCE

Even though no actual written records exist giving accounts of the practises of the ancient Maya, survivals among the Indians of today, evidences from archaeological investigations, and studies on the distribution of species of plants give important clues. The distribution of certain species can be explained satisfactorily by taking into account the rôle which they have played among the Maya.

The *ramon* tree, *Brosimum alicastrum*, appears on Maya ruins in dense groves, giving the climax association known as the *ramonal* (Plate 3). Today in the peninsula *ramon* trees are planted and protected for a twofold purpose: the leaves and small twigs are used for forage and the fruit for food. The ancient Maya certainly planted the tree also, but for food only. The sweet pulp of the fruit is eaten raw, and the hard starchy seed is ground, giving a black flour (Thompson, 1930, p. 185).

From the fact that the *ramon* trees dominate on the ancient sites, we may assume that the dominance is due to an initial advantage accruing to the species through its presence in large numbers when the places were abandoned. The trees are today important to some of the Maya as a supplementary source of food; that they were of much greater importance to the ancient Maya is a logical conclusion. The tree is probably a relic of ancient horticulture.

The most important association of the climax formation is the *zapotal* characterized by the *zapote* or *chicozapote*, *Achras zapota*. The tree thrives in the limestone country of the Yucatan Peninsula, where it occurs in sufficient numbers to be of great economic importance (see pp. 14 and 37). It is tolerant, slow-growing, and I estimate that some of the giants of Northern Petén are 1000 years old. We may account for the dominance of the species in two ways, both of which may have been contributing factors.

The *chicozapote* occurs as a stunted tree in margin lands around the swamps, on the dry rocky hill caps, and in the intermediate zone between the broad-leaved

and coniferous forests in northern British Honduras. This margin land is of questionable value for agriculture and probably remained undisturbed except for the removal of fire-wood and useful timber. From such areas the *zapote* may have spread into the more favorable uplands as the land was abandoned, and through its aggressiveness, tolerance, and longevity become dominant.

On the other hand, its dominance may be due largely to Maya influence. *Achras zapota* undoubtedly was present in the upland forest areas during all the period of Maya occupancy. We may assume, therefore, that some trees were spared when clearings were made, thus giving them an advantage over the other vegetation when the areas were abandoned. This practise of leaving certain valuable species when the forest is felled is found among the bush Maya of today and the Batak of Sumatra (Bartlett, 1935b, p. 16).

*Zapote* wood was used by the Maya for lintels and beams. It is extremely hard, durable, and fine-grained. The tree is a source of gum and a delicious fragrant fruit. With only honey as a source of sweets, fruits such as those of the *zapote* were undoubtedly prized by the Maya. Today the trees are occasionally planted in the villages for fruit.

In view of these facts, it is probable that the ancient Maya planted the species and also spared it in making clearings. Therefore, when the land was abandoned, these advantages gave it a position which it has maintained.

Among other valuable fruit and food trees whose presence in certain areas may be attributed to the Maya are the *guayo*, *Talisia olivæformis*, the *on* or *aguacate*, *Persea americana*, the mamey apple, *Calocarpum mammosum*, and the "cherry," *Pseudolmedia spuria*, known to the Maya as *manax*. From the seed of the *corozo* palm, *Orbignya cohune*, the present Maya of the Santa Cruz country obtain oil for cooking, and the ancient Maya may have done the same. Other common forest trees, the *copal* or *pom*, *Protium copal*, the *cedro*, *Cedrela mexicana*, the *caoba*, *Swietenia macrophylla*, and the *chacah* or gumbo limbo, *Bursera simaruba*, are valued for their resin, and may have been exploited by the ancients for the same product. To enumerate all the food, fruit, medicinal, ceremonial, and ornamental plants of the Maya is beyond the scope of the present report, and moreover, impossible because of the limited amount of botanical exploration that has been undertaken to date. The list of all the plants which are in some way related to the Maya would include almost the entire native flora of the Maya area and many species probably introduced by the ancients.

#### AGRICULTURE AND FIRE DESTRUCTION

The *milpa* system of agriculture is worldwide in distribution, being found in all forested tropical lowlands. It is characterized by the growing of crops in temporary clearings which after one or two years are abandoned to the wild vegetation.

In the Yucatan Peninsula the Maya use the *milpa* system exclusively for growing maize and beans, the two staple food crops. Beginning as early as November and continuing as late as March, bush is felled. The smaller trees, shrubs, lianas, herbs, and the smaller branches of the large trees are cut up, piled on the

larger wood, and allowed to dry. Late in April, or May, toward the end of the dry season, the brush is burned. Where green tree trunks and larger limbs are present, these remain unburned, but they are not a major hindrance in this type of agriculture (Plates 4 and 5).

When high climax forest is felled for making *milpas*, the Indians spare some large trees of such valuable sorts as the *zapote*, *ramon*, and thatch palms. When a clearing is made in a *corozal*, some of the *corozo* palms as well as large trees are left standing. However, in somewhat densely populated areas, as in Northern Yucatan, very few, if any, of the old forest trees survive the successive clearings and subsequent fires.

The rains begin sometimes late in April, but more often in May, at which time corn is planted in holes made with sharp-pointed sticks. During the growing season the large weeds may be pulled up or cut several times, this being the extent of cultivation. Beans, squashes, and gourds are planted along with the maize.

The crop of the *milpa* is best the first year, the second the yield of corn diminishes, and in the third year the area is abandoned and another site chosen and cleared. The same cycle is repeated over and over.

In addition to the *milpas* some Maya may have a semi-permanent and a permanent plot for other crops, the first located in or near the *milpa*, the latter in enclosures around the huts (Plate 6). The plot near the *milpa* generally contains perennial herbs such as the banana, plantain, *macal*, and in addition, sweet potatoes, peppers, and tomatoes.

The village enclosures contain such trees as the *aguacate*, *caimito*, *guayabo*, cacao, and coffee (Plate 6). The herbaceous plants include the *chayote*, *papayo*, banana, plantain, tomato, sweet potato, and peppers. Ornamental and medicinal shrubs and herbs are very prominent. If cotton is raised, it is generally planted in the dooryard.

Little study has been given to the conditions which result from *milpa* agriculture. The yields of corn diminish considerably the second year and the clearings are generally abandoned. Rank secondary bush rapidly reclaims the areas and various successional stages follow (see pp. 46, 145, and 194, and Lundell, 1934b, pp. 272-273). As the woody vegetation becomes reestablished, the weedy herbaceous growth is smothered out. In secondary bush only 10 meters high, only a few shade-tolerant grasses and other scattered heliophobous herbs may be encountered.

Emerson and Kempton<sup>1</sup> found in their brief survey of agronomic conditions in northern Yucatan that the competition of weeds probably has much to do with the lessened corn yields after the first planting. Would the control of weeds make possible long-continued cultivation of the same land? That is one of the major questions which must be carefully investigated. Another important consideration from the historical standpoint is to determine the effect of continued *milpa* rotation on the regeneration of forest. If *milpa* rotation, continued over centuries, results in progressively longer periods for regeneration of the forest between clear-

<sup>1</sup> R. A. Emerson and J. H. Kempton visited Yucatan in February 1935, under the auspices of the Carnegie Institution, to make a preliminary survey of agronomic conditions.



ings, then *milpa* agriculture is a system which will lead eventually to a condition where the land will not support any considerable population.

Concerning the effect of *milpa* agriculture upon the native vegetation and the soils, the following statements are worthy of note. Cook (1919, pp. 310 and 311) points out:

"... The woody growth is restored less rapidly after each agricultural clearing, and a state of complete denudation and exhaustion of the soil may be reached if the burnings continue. A region that has been exploited thoroughly by the *milpa* system may require many decades, and even centuries, before the fertility of the soil is fully restored."

"In a virgin-forest clearing the wild vegetation may begin to reassert itself even in advance of the maturity of the crop. Sprouts may come up from the stumps or from plants with underground rootstocks that are not killed by the fire, and rank weeds appear. With a moist climate and a rich soil the growth of woody plants may be sufficient in a few months to permit the same land to be burned and planted again in the second or third year, but this is true only of clearings in old or virgin forest. A longer period of renewal is required after the second burning, before there is enough bush to burn again, and the interval lengthens gradually to the fifth, seventh, or tenth year, depending upon the soil and other local conditions, but also very largely upon the length of time that the district has been occupied since the original forest growth was destroyed."

"That the bush takes longer to renew itself after each successive cutting and burning means, of course, that the soil is becoming less fertile. The genuine forest growth gives place to other plants that are adapted to the more open and exposed conditions of the burnt-over lands, and eventually some of the large perennial grasses become established. Though grass burns readily in the dry season, the roots and rootstocks are not injured and continue to occupy the soil to the exclusion of other plants. The method of cutting and burning serves to clear land of woody vegetation, but becomes ineffective when the land is occupied with grasses that resist fire. Accumulations of dry grass make fire hot enough to destroy seedlings of other plants, or even to kill large trees when the heat is carried by wind."

"The self-limiting character of *milpa* agriculture does not result solely from burning the clearings that have been cut for planting, but also from the fire spreading to neighboring bush or grasslands. Where only 5 or 10 acres have been cut 100 or 1000 acres may be burned over. . ."

"... When the process of denudation has gone so far that land for *milpas* can no longer be cleared and planted by the native methods, the period of agricultural occupation is at an end. Thus the *milpa* system carries with it the agency of its own destruction in producing the grasslands that are not amenable to the kind of cultivation that the system provides, and the process tends to accelerate as the limit is approached. . ."

In discussing savanna soils, Ramann (1928, pp. 111-112) makes the following significant statement:

"The conditions are greatly changed under the destructive system of cultivation adopted by the African natives. The forest is burnt down to provide land for cultivation. As a result of this system the nutrient salts present in the plants are rendered soluble and to a large extent are lost from the soil by leaching. When it is no longer possible to obtain a crop, the field is abandoned and allowed to revert to bush and then is again made available for cropping by burning off the scrub which has grown upon it. This process is repeated so long as a crop can be obtained. The final result is not only the exhaustion of the soil, but the destruction or diminution in number of soil organisms. The relation

between the natural plant covering and the soil is perennially disturbed. The physical properties of the soil are injured by the repeated exposure and denudation; the soil fauna is unable to withstand such treatment and is permanently suppressed. . . Steppe fires ensure the permanence of this condition. . ."

The opinions of Cook and Ramann concerning the effect of *milpa* agriculture on vegetation and edaphic conditions are highly interesting and worthy of full consideration in attacking the problems. My field observations through the Yucatan Peninsula have led me to similar conclusions with certain modifications.

From historical evidence it is known that northern Yucatan has supported a considerable population for the past eight or nine centuries. That area today is covered with brushlands. There is no evidence to the contrary that *milpa* agriculture under present conditions (of climate and population) could not continue indefinitely. It appears that continued rotation there does not lead to grasslands, but to brushlands. A reason for this may possibly be found in considering the soils. For, as already stated, over the greater part of northern Yucatan the soil consists of a shallow mantle of red earth often confined to pockets of outcropping limestone. On this thin mantle of calcareous soil, woody growth appears more vigorous than grassy growth, hence thickets and not grasslands characterize the region.

On the other hand, those areas of the Yucatan Peninsula where the soils are deep appear to become grasslands as a result of long-continued *milpa* rotation. The savannas of the Los Chenes area of Campeche and in central Petén are areas with deep soils.

Although grasses have not overrun the shallow soils of northern Yucatan, we have no assurances that they would not do so if the periods between *milpa* clearings were progressively shortened with increase of population. Observations indicate that the occupation of areas of shallow calcareous soils by grasslands is a slow process and possibly only temporary, but the occupation of areas of deep soils by grasses is more rapid, resulting in the formation of savannas.

*Milpa* agriculture and the accompanying fires profoundly affect the native vegetation. The brushlands of the northern section of the peninsula and the areas of savanna in central Petén and the Los Chenes country of Campeche do not represent natural vegetation, but vegetation resulting from long-continued disturbances.

#### CHICLE EXPLOITATION

The gum giving the chewy qualities to chewing gum is chicle, obtained from the *zapote*, *Achras zapota* (Lundell, 1933b). During the last four decades the demand for gum has led to intensive exploitation of the sapodilla forest of the Yucatan Peninsula. Inasmuch as Northern Petén contains the best phase of this forest, it has been one of the areas most thoroughly exploited.

By tapping the trees a creamy latex is obtained which when coagulated gives the chicle gum. The tapping is done in the period from June to February. The entire boles of the trees up to the crotch and even the limbs are bled (Plate 7). The tappers, "*chicleros*," go out into the jungle to tap at random, generally in an

area within walking distance of the temporary bush camps where they live during the season.

*Chicleros* are paid by the pound for the gum they produce, so they obtain the largest possible yield from each tree, not giving heed to the damage done to the forest by injuring the trees. Their work is not supervised. In many respects the system of exploitation is analogous to that which existed in the wilds of Brazil during the early days of rubber production.

In tapping, the sole tool used is the machete. The tapping wounds, extending zigzag up the entire bole of the tree at intervals of about 16 inches, heal slowly, generally taking from two to five years, depending on the extent of the injuries to the cortex (Plate 7). The cambium is severed by most of the machete cuts and the drying out of the cortex exposes the wood before callus has time to cover it. Observations indicate that about five per cent of the trees die after each tapping, largely from the ravages of wood-boring insects and wood-decaying organisms. No tapped tree will yield enough latex to justify retapping within five years at the least, and a longer rest period is preferable.

Chicle exploitation is important in considering the vegetation. The balance of the climax formation is upset by the gradual killing of the dominant species even though the process may extend over more than a century. The climatic climax forest today is essentially a culled forest, yet the *zapote* is still present in sufficient numbers to dominate much of the uplands. Even if the peak production of 1927, 1928, and 1929, when about twelve million pounds of chicle were annually exported from the Yucatan Peninsula, had been continued, the species would still dominate large areas of the forest for another century. However, if exploitation continues, much-altered forest conditions will result eventually. Whether *Achras zapota* would again become dominant after losing its position is a question only to be answered by future observations.

In the more accessible areas where exploitation has been continued longest, very few sapodillas remain. In like areas, as along the San Pedro de Martir River in Northern Petén, the mahogany trees have been cut also, thus leaving culled forest in which neither of the two species is prominent. It will be important to determine the characteristic species of the culled forest and to follow the changes which take place.

In summarizing the history of the modification of the vegetation in Northern Petén, the following points stand out: (1) The greater part of the upland forest of Northern Petén was probably felled during the Old Empire period of the Maya; (2) the Old Empire declined, and the population had so greatly decreased by about A. D. 1000 that much of the uplands was practically abandoned, thus leaving a period of from 800 to 900 years for the climatic climax forest to reach its present state; (3) trees such as the *zapote* and *ramon* were doubtlessly protected and planted by the Maya, and hence gained an advantage over the other vegetation when the uplands were abandoned; (4) the destructive *milpa* system of today possibly existed in its present form over a large part of the area; (5) the careless burning

of brush coupled with occasional extremely dry seasons has often led to considerable fire destruction; (6) long-continued *milpa* agriculture and fire destruction have so changed conditions in some localities that savannas exist even though not particularly favored by the climate and soils; and (7) during the last four decades, chicle exploitation and mahogany logging operations have left a culled climax forest. In some areas both species have been largely eliminated.

#### CLASSIFICATION OF THE VEGETATION

A general account of the Yucatan vegetation from an ecological standpoint was presented in the *Preliminary sketch of the phytogeography of the Yucatan Peninsula* (Lundell, 1934b). The peninsula, southward to Lake Petén, was divided into five minor phytogeographical divisions: Southern Campeche, Southwestern Campeche, Northern Yucatan, Eastern Coast, and Northern Petén. Three of these were described; annotated lists of the species were given for all of the associations studied. Formations were delimited on a topographical and edaphic basis.

In the present treatise on the vegetation of Petén, the method of presentation has been modified. The terminology follows more closely that in general use by ecologists and phytosociologists. The term "formation" is restricted to designate only climatic climax vegetation which in Northern Petén is represented by luxuriant broad-leaved forest of the well-drained uplands. As in the preliminary sketch, the term "association" is broadly applied to plant communities, regardless of size, which may be unmistakably recognized by physiographic position, physiognomy, and floristic composition. In each association, whether successional or climax, primary or secondary, certain more or less exclusive species stand out as indicators.

In view of the history of the vegetation of Northern Petén and the peninsula in its entirety, it is apparent that much of the vegetation was subject to retrogression over long periods. Concerning such a condition, we find in Braun-Blanquet (*Plant sociology*, 1932, p. 322) the following statement:

"Many natural phenomena, like earthquakes, avalanches, brief flooding, and many human activities, like clearing and fire, do not completely destroy the existing vegetation. They cause retrogression, reversions, and delays. Regeneration in such cases begins not with a pioneer stage as on new land but with a suitable stage of the original sere. This results in a partial sere, which sooner or later runs into the original sere, provided its development is not stopped by man."

In spite of earlier disturbed conditions, the original complete sere is now evident again in Northern Petén over the greater part of the area, and the climax stage has been reached in the uplands. Therefore, I have set up three major divisions in grouping the associations: (1) the primary successional stages; (2) the climax formation; and (3) the secondary successional stages, the last evident in disturbed areas where the influence of man, fire, and other destructive forces are apparent.

When critical taxonomic studies of the flora are undertaken, many of the specific names will undoubtedly be thrown into synonymy, while on the other hand

some synonyms will be revived. Other species may be split or described as new. Also, the identifications of some of the species are doubtful to say the least. In view of this condition I am citing the collection number of every specimen in order that the specimens may serve as vouchers for reference, thereby insuring that the value of the ecological work shall not be lost in the flux of scientific names. Because of the inadequacy of past botanical exploration, it has been necessary to work out the flora in conjunction with the ecological survey.

The nomenclature used by Standley in his *Flora of Yucatan* is followed in this report.

#### PRIMARY SUCCESSIONAL STAGES

##### LAKES AND BANKS

**LAKE ZOTZ**<sup>1</sup>—Lake Zotz is a small body of comparatively shallow water located about 10 kilometers southeast of Laguna Perdida on the road leading to Lake Petén (Plate 1). The lake is somewhat oval and less than a kilometer wide.

It was formerly surrounded by high forest, most of which has been felled to make way for *milpas* and *zacatales* (grass plots). The station at the lake, known as El Zotz,<sup>2</sup> is important as one of the overnight stopping places for mule-trains carrying in merchandise and bringing out chicle from the region to the northwest.

During the one day spent exploring the basin, a representative collection of the plants from each association was obtained. Other botanists who may visit the lake are urged to collect more thoroughly as some interesting species were undoubtedly overlooked.

*Submerged hydrophytes*—The association may be limited to one or at the most a half-dozen species, yet the number of individual plants may be enormous. In Lake Zotz compact beds of *Cabomba aquatica* extend out in shallow water as much as 100 meters from the edge of the floating fern and sedge bog.

*Floating fern and sedge bog*—About one-fifth of the surface of Lake Zotz is covered with a matted, floating, saturated mass of intertwined, fibrous, organic material which supports a distinctive association of plants adapted to a semi-aquatic or aquatic habitat (Plates 8 and 9). Although the species represented are altogether different and no sphagnum is present, the general aspects of the mat suggest a sphagnum bog. Scores of species, some equally distributed throughout, others occurring in large dense patches, comprise the association.

Ferns and sedges dominate, yet species of other genera such as *Typha* stand out prominently. The ferns include *Acrostichum daneifolium* (Lundell 3310),<sup>3</sup> *Blechnum serrulatum* (3309), *Dryopteris serrata* (3297), and *Nephrolepis biserrata* (3320). They are gregarious, growing in large patches so closely grouped together that from a distance sections of the association appear to consist entirely of ferns.

<sup>1</sup> Whenever the data are available each lake, river, *aguada*, *akalche*, etc., will be treated separately in order to give a clear conception of the nature of the associations of each. When the survey is completed it will then be possible to make exact analyses and comparisons between associations belonging to the same physiographical areas in various sections of the region.

<sup>2</sup> Zotz is often spelled "Sos" or "Zos."

<sup>3</sup> Throughout the book, if collector of cited specimens is always the same, the name of the collector precedes the number only for first citation in each paragraph.



The species of *Acrostichum*, *Blechnum*, and *Dryopteris* are large and coarse, often exceeding 1 meter in height.

Sedges of similar habit are *Scleria eggersiana* (Lundell 3312), *Fuirena umbellata* (3292, 3979), and the *polol*, *Cyperus articulatus* (3321). A diminutive form, *Eleocharis plicarhachis* (3325), must be considered as one of the important elements. Other sedges are *Eleocharis interstincta* (3326) and a large *Scleria* (3317) which was not fruiting.

*Typha angustifolia* (Lundell 3315) appears in characteristic clumps. Scattered widely through the association are two orchids, *Habenaria pringlei* (3324) and *Bletia tuberosa* (3323), along with *Thalia geniculata* (3300), *Jussiaea leptocarpa* (3319), *Erechtites hieracifolia* (3294), *Polygonum acuminatum* (3298), *Andropogon bicornis* (3316), *Begonia towarensis* (3291), *Helianthium tenellum* (3293), and the slender vine, *Vigna repens* (3299). Along the outer edge of the mat, *Utricularia macerrima* (?) (3369) grows profusely.

The characteristic species of free-floating hydrophytes, *Salvinia*, *Pistia*, and *Eichhornia*, were not encountered. Samples taken of the plankton reveal a large microscopic flora much richer than in Lake Petén.

*Shallow water association*—Along the strand where the matted floating mass is not jammed against the bank, the *naabal*, a water-lily association, appears (Plate 9, fig. 2). The *naab*, *Nymphaea ampla* (Lundell 3313), with its large floating leaves, is dominant. The subdominants, mostly coarse gregarious aquatics, are the *polol* sedges, *Cyperus articulatus* and *Eleocharis interstincta*, the *colahuete* or *carrizo*, *Phragmites communis* (3311), and *Typha angustifolia*. A common margin plant is *Polygonum acuminatum* (3298), a slender herb as much as a meter high.

*Bank associations*—The exposed bank at low-water time and a narrow zone of saturated soil above the high-water level support an herbaceous association in which *Spilanthes americana* (Lundell 3301) and *Panicum trichanthum* (3307) alternate as dominants over extended sections. With these appears *Rynchospora corymbosa* (3304). Where the banks slope very gradually, areas of *Eleocharis interstincta* fringe the strand during the low-water period. Gregarious forms, the giant *Scleria eggersiana* (3312) and species of *Heliconia*, occupy areas of moist soil in the zone lying above that subject to long periods of inundation.

This herbaceous association is most prominent on the sides of the lake where the forest has been felled, and to a certain extent it may be considered secondary. Where trees extend to the water edge, the shade prevents a luxuriant herbaceous growth on the strand.

No study was made in the undisturbed sector of the trees and shrubs of the transitional zone leading to the upland climax forest. The secondary upland growth above the herbaceous association is a *guarumal* characterized by the *guarumo*, *Cecropia* (Lundell 3295, 3296). On the steep bank near the station stand *Ficus segoviae* (3274) and *Ficus tuerckheimii* (3275), trees about 15 meters high with large spreading crowns. Near the water edge there are smaller trees of *Pachira aquatica*.

**LAKE PETÉN**—Lake Petén is a great body of fresh water about 16 kilometers long and 3 kilometers wide. It is part of the chain of east-west lakes which extend from Lake Yaxha westward to Laguna Perdida. The deepest parts of Lake Petén are on the north side where the cliffs and hills rise steeply more than 200 meters above the lake surface and the banks extend downward almost vertically into the lake (see Plate 10, in pocket inside back cover). The southern, eastern, and western sides are low and somewhat swampy. The Tayasal peninsula juts out at the western end (Plate 10).

Most of the population of the Department of Petén is concentrated in the island city of Flores, the governmental seat, and in villages and *ranchos* surrounding the lake (Plates 2 and 11, fig. 2). The chief villages are San Andres, San Jose, Remate, and San Benito. Small plantations, settlements, *milpas*, *zacatales*, and *potreros* cover extended areas. The Tayasal peninsula has recently been resettled. West of Flores on the mainland lies the air field clearing.

At the east end are two creeks, Ixlu and Ixpop, which flow into the lake, and at the west end a small river enters (Plate 10). In spite of the large amount of water which pours in during the rainy season, the lake is quite clear at all times. Winds sweep up the trough-like depression with considerable force, especially from the east, and the wave action has led to the formation of small beaches at Nictun and other points (Plate 10). The distribution of the hydrophytic associations may be accounted for in part by the degree of exposure to wave action.

**Submerged hydrophytes**—Beds of *Cabomba aquatica* and *Naias guadalupensis* (Lundell 2027, 2029) are to be found throughout the littoral zone in quiet waters. The growth of the former is most luxuriant in coves and inlets. *Potamogeton lucens* (2028, 3221) appears in patches in the shallower water even where wave action is considerable. Stiff, wave-resistant species of *Chara* grow in the water along the beaches; clumps of *Chara* and *Nitella* are present in the deeper water.

**Free-floating aquatics**—The two floating species of first importance are *Eichhornia crassipes*, called *ninfa*, and *Pistia stratiotes* (Aguilar 160), the common *lechuga* known to the Maya as *xicinchah*, both of which cover wide stretches of relatively quiet water. Where the *lechuga* is dominant, the association is designated as a *lechugal*. The largest stretch of *Eichhornia* was observed along the shore between San Benito and the Campo Aviacion, where it appeared stunted.

**Shallow water associations**—The associations form two large groups: (1) those of relatively calm waters; and (2) those in areas subject to continual wave action. The *naabal* belongs to the former, while the *saibalal*,<sup>1</sup> bulrush (*Eleocharis*), and *carrizal* associations are common to the latter.

The characteristic water-lily association, the *naabal*, is dominated by the *naab*, *Nymphaea ampla* (Lundell 3240), as shown in Plate 12. With it is found *Limnanthemum humboldtianum* (4301), a gentian with small floating peltate leaves. In the *naabal* are small clumps of the giant coarse *saibal* sedge, *Cladium jamaicense* (3119), clumps of the giant reed, *Phragmites communis* (3120), known as *carrizo*

<sup>1</sup> In Lundell, 1934b, p. 270, the association was erroneously designated as *saibal*, the latter term being the vernacular name of the plant.

and *colahuete*, patches of the *polol* sedges, *Cyperus articulatus* and *Eleocharis interstincta*, and small areas of *Typha angustifolia* (3219).

If the clumps of the *carrizo*, *Phragmites communis*, are very frequent so as to characterize the areas, the association is known as the *carrizal*. The *carrizo* dominates mostly in areas where there is considerable wave action. If the *saibal* sedges are most prominent, then the water-lilies may be inconspicuous, largely confined to small, sheltered, leeward areas.

In the quiet waters of the *naabal* and occasionally in the *carrizal* and bulrush associations where wave action is inconsiderable, beds of *Naias*, *Cabomba*, *Chara*, *Nitella*, as well as numbers of the floating species, *Eichhornia* and *Pistia*, invade the area. *Eichhornia*, because of the dense floating mass it forms, undoubtedly smothers out the submerged species as well as those prominent in the *naabal*, when it becomes well established in a favorable locality.

The bulrush association dominated by *Eleocharis interstincta* (Lundell 3974, 3975) is resistant to considerable wave action and characterizes long stretches of the shore. Often it forms an outer belt with the *naabal* and *Eichhornia-Pistia* floating associations lying leeward in the sheltered zone.

The *saibalal*, made up almost exclusively of *Cladium jamaicense* (Lundell 3119), is found along the entire southern shore of Lake Petén and in other areas subject to the beating of the waves. It grows very densely and often towers as much as two meters above the water surface. It is coarse, very resistant, with saw-toothed blades; the penetration of the areas it dominates is painful and difficult. With the rise and fall of the large waves, the mass of vegetation sways, becomes submerged, and then rises again in rhythmic beat. Occasionally on the leeward side near the shore, the calm water associations are encountered.

In summarizing the characteristics of all the hydrophytic associations of the littoral zone we note (1) that in the calm waters and leeward areas are found the submerged associations of *Naias*, *Cabomba*, *Chara*, and *Nitella*, the floating associations of *Eichhornia* and *Pistia*, and the shallow water association characterized by *Nymphaea*; (2) that in areas moderately affected by wave action are encountered the submerged association consisting of beds of *Potamogeton* and scattered clumps of small, wiry, resistant species of *Chara*, as well as the shallow-water associations typified by clumps of *Phragmites* and *Cladium*; and (3) that in the areas beaten by the waves are the bulrush and *saibalal* associations dominated respectively by *Eleocharis* and *Cladium*.

*Bank associations*—The associations in this category around Lake Petén are those of the beaches, low mud banks, marshes, and steep banks. The man-influenced areas such as the inhabited clearings and sugarcane plantations will be discussed under the secondary successional stages.

Since 1929 the water-level of Lake Petén has been rising annually so that much of the shore has been inundated, with the result that the aspects of the lower banks are constantly changing. In addition, the level of the lake fluctuates considerably between wet and dry seasons, and with the rise of the high-water level, each suc-

cessive wet season has led to further extension of the shore line. Extensive areas of the littoral zone are marked by dead trees and stumps of fallen trees. Scores of buildings in the city of Flores and in the villages around the lake have been flooded and abandoned. Plates 2 and 11, figure 2, show the ancient beach line of the lake, estimated to be about 20 meters above the present level.

The recent rise of the water-level has led to an invasion of the recently submerged shore by strictly hydrophytic species of the genera *Nymphæa*, *Cladium*, *Eleocharis*, *Typha*, *Scirpus*, *Cyperus*, etc., and of the saturated banks by characteristic species of *Panicum*, *Lippia*, *Egletes*, *Spilanthus*, *Eleocharis*, etc.

Nictun point (Plate 13, fig. 1) at the west end of the lake is low. The waves wash its shore, continually piling up small shells and sand, thus forming a narrow beach. During the flood season, water covers the area. The association is typically herbaceous, but a few woody relics remain. When I collected in the area during the dry season when the water had receded, I found growing on the sand and mud nearest the water edge the small sedges including *Eleocharis caribæa* (Lundell 3141) and *Dichromena colorata* (3147), the prostrate, creeping *Lippia nodiflora* (3149), and two composites, *Calea trichotoma* (3158) and *Wedelia acapulcensis* (?) (3127).

On slightly higher, less saturated soil, there was a much denser herbaceous growth of the composites, *Viguiera dentata* var. *helianthoides* (Lundell 3160), *Bidens pilosa* var. *radiata* (3137), *Ageratum corymbosum* var. *latifolium* (3145); three vines, *Passiflora foetida lanuginosa* (3125), *Phaseolus atropurpureus* (3151), known as *uaco*, and *Cucurbita radicans* (3152); the erect weeds, *Asclepias curassavica* (3154), *Jussiaea suffruticosa* (3156); and other species including the *tubux*, *Cyperus oxycarioides* (3155), the *verjena*, *Teucrium inflatum* (3148), the *antaniza*, *Borreria verticillata* (3150), the *dzitze cimarron*, *Lisianthus axillaris* (3153, 3159), the *altanecia*, *Cynoctonum mitreola* (3146), and *Ruellia nudiflora* var. *yucatanica* (3216).

Intertwined on several of the herbs I found the parasitic lauraceous vine, *Cassytha filiformis* (Lundell 3124), known as *sueldo con sueldo*.

The only shrub collected was *Piper curvatipes* (Lundell 3122), a new species. The low relic trees were *Diphyssa carthagenensis* (3140), known as *zuzul*, and the common *chechem negra*, *Metopium brownei*.

Between the villages of San Andres and San Jose on the north shore is a low marshy area where the small filiform *Eleocharis caribæa* (Lundell 3220) and other sedges dominate. On dead trees in this same area, the *pitahaya*, *Cereus undatus* (3235), a large root-climbing epiphyte forming a massive growth, was collected. The fruit of this cactus is said to be edible.

On the north shore of Lake Petén the rocky precipitous banks support a luxuriant marginal forest. The trees of the lower zone where the soil is moist from capillary water are species of *Pachira*, *Bucida*, *Ficus*, and the *poloc*, *Talisia floresii* (Lundell 3121). The large coarse lianas include *Capparis flexuosa* (3129), called *potal*, *Gymnopodium floribundum* (3139), *Pithecolobium platylobum* (?) (3116), and *Randia armata* (3117).

Trees and shrubs on the steep rocky bank are the *tzalam*, *Lysiloma bahamense* (Lundell 3184), the *chacah*, *Bursera simaruba* (3118), the *jaboncillo*, *Diospyros yucatanensis* (3237), *Capparis lundellii* (3115, 3201), *Coussapoa oligocephala* (3170), and *Acalypha villosa* (3198). Of the vines I collected the slender *Stigmaphyllon ellipticum* (3128) and the scrambling *Otopappus scaber* (3200). One of the commonest epiphytes is the scandent fern, *Polypodium palmeri* (3222). Near the water edge in an open area I collected the weedy herb, *Alternanthera brasiliensis* (3199).

It is hoped that these preliminary studies on Lake Petén can be followed by a detailed survey.

What has been said concerning the rise of the water-level in Lake Petén is true also of Lake Yaxha, Laguna Perdida, and doubtlessly of other Petén lakes. Around Lake Yaxha dead trees line the shore, of which the *tzalam*, *Lysiloma bahamensis* (Lundell 2149) is one of the commonest.

Low and swampy lake banks are covered with swamp forest of the type described on pages 27 to 30 (see Plate 14, in pocket inside back cover). The east end of Lake Yaxha terminates in an *akalche* in which scrubby *Albizia* (?) and other leguminous species dominate. Between the village of Yaxha and the overnight stopping place called Ixtinto there is an extensive *escobal*. Isabelita, a chicle station in northwestern Petén, is located on a large lake, the northern section of which ends in an extensive *akalche*.

The transition from the lake associations to the climax forest in undisturbed sectors may be rapid when the bank is steep, while on the other hand, when the banks rise very gently, the *botanal* and *corozal* may be encountered (see Plate 14).

The rise and fall of the water-level in the Petén lakes appears to be of cyclic occurrence, connected with the cycles of wet and dry years. During years when the water-level recedes, savanna-like marginal zones dominated by *Eleocharis* species and other hygrophilous herbs have an ephemeral existence. To a limited extent these savanna-like zones appear each year as the water-level fluctuates between the wet and dry seasons.

In the following systematic list I include the hydrophytes and all other species which were noted or collected in and around the lakes of Northern Petén. The collection numbers are those of the writer, unless otherwise indicated.

#### TREES:

Moraceæ	<i>Coussapoa oligocephala</i> Donn. Sm. 3170.
	<i>Ficus segoviae</i> Miq. Copo. 3274.
	<i>Ficus tuerckheimii</i> Standl. Copo. 3275.
Capparidaceæ	<i>Capparis lundellii</i> Standl. 3115, 3201.
Leguminosæ	<i>Lysiloma bahamensis</i> Benth. Tzalam. 2149, 3184.
Burseraceæ	<i>Bursera simaruba</i> (L.) Sarg. Chacah. 3118.
Anacardiaceæ	<i>Metopium brownei</i> (Jacq.) Urban. Chechem.
Sapindaceæ	<i>Talisia floresii</i> Standl. Poloc. 3121.
Bombacaceæ	<i>Pachira aquatica</i> Aubl. Zapotobobo.
Combretaceæ	<i>Bucida buceras</i> L. Pucte.

#### SHRUBS OR TREELETS:

Piperaceæ	<i>Piper curvatipes</i> Trel. 3122.
Leguminosæ	<i>Diphysa carthagenensis</i> Jacq. Zuzul. 3140.
	<i>Mimosa pigra</i> L. Zarza. 2148.



- Euphorbiaceæ *Acalypha villosa* Jacq. 3198.  
 Ebenaceæ *Diospyros yucatanensis* Lundell. *Jaboncillo*. 3237.
- LIANAS:
- Polygonaceæ *Gymnopodium floribundum* Rolfe. 3139.  
 Capparidaceæ *Capparis flexuosa* L. *Potal*. 3129.  
 Leguminosæ *Pithecolobium platylobum* (Spreng.) Urb. (?). 3116.  
 Malpighiaceæ *Stigmaphyllon ellipticum* (HBK.) A. Juss. 3128.  
 Rubiaceæ *Randia armata* (Sw.) DC. 3117.
- HERBACEOUS VINES:
- Lauraceæ *Cassytha filiformis* L. *Sueldo con sueldo*. 3124. Parasitic.  
 Leguminosæ *Phaseolus atropurpureus* DC. *Uaco*. 3151.  
*Vigna repens* (L.) Kuntze. 3299.  
 Passifloraceæ *Passiflora foetida lanuginosa* Killip. 3125.  
 Cucurbitaceæ *Cucurbita radicans* Naud. 3152.
- HERBS:
- Polypodiaceæ *Acrostichum daneifolium* L. & F. 3310.  
*Blechnum serrulatum* Rich. 3309.  
*Dryopteris gongylodes* (Schkuhr.) Kuntze. 3318.  
*Dryopteris serrata* (Cav.) C. Chr. 3297.  
*Nephrolepis biserrata* (Sw.) Schott. 3320.  
 Typhaceæ *Typha angustifolia* L. 3219, 3315.  
 Naiadaceæ *Naias guadalupensis* (Spreng.) Morong. 2027, 2029, 2206, 2207.  
*Potamogeton lucens* L. 2028, 2204, 2205, 3221.  
 Alismaceæ *Helianthium tenellum* (Mart.) Britton. 3293.  
 Gramineæ *Andropogon bicornis* L. 3316.  
*Panicum trichanthum* Nees. 3307.  
*Phragmites communis* Trin. *Colahuete, Carrizo*. 3120, 3311.  
 Cyperaceæ *Cladium jamaicense* Crantz. *Saibal*. 3119.  
*Cyperus articulatus* L. *Polol*. 3218, 3321.  
*Cyperus oxycarioides* Britton. *Tubux*. 3155.  
*Dichromena colorata* (L.) Hitchc. 3147.  
*Eleocharis caribæa* (Rottb.) Blake. 2018, 3141, 3220.  
*Eleocharis interstincta* (Vahl) R. & S. *Polol, Polol macho*. 3326, 3974, 3975.  
*Eleocharis plicarhachis* (Griseb.) Svenson. 3325.  
*Fuirena incompleta* Nees. *Tubux*. 3126.  
*Fuirena umbellata* Rottb. 3292, 3979.  
*Rynchospora corymbosa* (L.) Britton. 3304.  
*Scirpus cubensis* Kunth. 3322.  
*Scleria eggersiana* Bœck. 3312.  
*Scleria* sp. 3317.  
 Bromeliaceæ *Pitcairnia recurvata* (Scheidw.) C. Koch. *Azucena silvestre*. 3217.  
 Araceæ *Pistia stratiotes* L. *Xicinchah, Lechuga*. *Aguilar* 160.  
 Pontederiaceæ *Eichhornia crassipes* (Mart.) Solms. *Ninfa*.  
 Marantaceæ *Thalia geniculata* L. 3300.  
 Orchidaceæ *Bletia tuberosa* (L.) Ames. 3323.  
*Habenaria pringlei* Robins. 3324.  
 Polygonaceæ *Polygonum acuminatum* HBK. 3298.  
 Amaranthaceæ *Alternanthera brasiliana* (L.) Kuntze. 3199, 4255.  
 Nymphaeaceæ *Cabomba aquatica* Aubl.  
*Nymphæa ampla* (Salisb.) DC. *Naab*. 3240, 3313.  
 Begoniaceæ *Begonia towarensis* Klotzsch. 3291.  
 Onagraceæ *Jussiaea leptocarpa* Nutt. 3319.  
*Jussiaea suffruticosa* L. 3156.  
 Loganiaceæ *Cynoctonum mitreola* (L.) Britton. *Altanecia*. 3146.  
 Gentianaceæ *Limnanthemum humboldtianum* (HBK.) Griseb. 4301.  
*Lisianthus axillaris* (Hemsl.) Kuntze. *Dzitze cimarron*. 3153, 3159.

Asclepiadaceæ	<i>Asclepias curassavica</i> L. 3154.
Verbenaceæ	<i>Lippia nodiflora</i> (L.) Michx. Orozus. 3149.
Labiataæ	<i>Teucrium inflatum</i> Sw. Verjena. 3148.
Lentibulariaceæ	<i>Utricularia macerrima</i> Blake. (?). 3369.
	<i>Utricularia obtusa</i> Sw. (?). 2085, 3272.
Acanthaceæ	<i>Ruellia nudiflora</i> var. <i>yucatanica</i> Leonard. 3216.
Rubiaceæ	<i>Borreria verticillata</i> (L.) Mey. Antaniza. 3150.
Compositæ	<i>Ageratum corymbosum</i> Zuccag. var. <i>latifolium</i> (DC.) Robinson. 3145.
	<i>Bidens pilosa</i> L. var. <i>radiata</i> Sch. Bip. 3137.
	<i>Calea trichotoma</i> Donn. Sm. 3158.
	<i>Erechtites hieracifolia</i> (L.) Raf. 3294.
	<i>Otopappus scaber</i> Blake. 3200.
	<i>Spilanthes americana</i> (Mutis.) Hieron. 3301.
	<i>Viguiera dentata</i> (Cav.) Spreng. var. <i>helianthoides</i> (HBK.) Blake. Makatze. 3160.
	<i>Wedelia acapulcensis</i> HBK. (?). 3127.

## EPIPHYTES:

Polypodiaceæ	<i>Polypodium palmeri</i> Maxon. 3222.
Cactaceæ	<i>Cereus undatus</i> Haw. Pitahaya. 3235.

## RIVERS AND BANKS

SAN PEDRO DE MARTIR RIVER—The San Pedro de Martir River of north-western Petén is one of the major tributaries of the Usumacintla River (Plate 1). It is navigable for smaller river boats to El Paso. In Petén it runs westward through one of the east-west troughs which cross the region. Its northern banks are precipitous, while the southern banks are mostly swampy.

I collected on the San Pedro de Martir River from El Paso down to La Pava, a distance said locally to be 10 leagues by water. Although no systematic study of the river and its banks was undertaken, many of the most characteristic associations were noted. In general the associations correspond closely to those previously described from the lakes.

*Free-floating aquatics*—In the areas with calm water and scattered in among the species of the marginal hydrophytic associations lie small patches of the *lechuga*, *Pistia stratiotes*, and the aquatic fern, *Salvinia auriculata* (Lundell 1565). Where *Pistia* is present in extensive mats, the area is designated as a *lechugal*.

*Submerged hydrophytes*—Beds and scattered patches of *Cabomba aquatica* are frequent in quiet or slow-flowing water in the San Pedro de Martir River (Lundell 1502) and in the Mopan River at Fallabon (2198). The species thrives best in inlets and sheltered areas.

*Stream-edge associations*—Many kilometers of the banks of the San Pedro de Martir River are characterized by the *saibalal*, almost a continuous growth of *Cladium jamaicense*. On the swampy southern side of the river the *saibalal* often merges into the *akalche*. Another aquatic sedge found commonly along the river edge is *Cyperus diffusus* (Lundell 1475).

The *naabal*, dominated by *Nymphæa ampla* (Lundell 1517), is not as prominent as in the lakes. However, patches of the *naab* are encountered in sheltered areas.

In inlets and along the muddy banks, an extensive growth of *Pontederia rotundifolia* (Lundell 1564) is characteristic. In a small shallow stream near

Isabelita on the San Felipe, Campeche-El Paso trail, I collected *Pontederia lanceolata* (1445).

*Bank associations*—Between the woody associations of the upper banks and the water-level of the dry season lies a zone of rich, moist, alluvial soils on which an herbaceous growth of hygrophilous species dominates. Two composites, *Egletes viscosa* (Lundell 1543) and *Spilanthes americana* (1449), a filiform sedge, *Eleocharis caribæa* (2152), and the prostrate *Alternanthera obovata* were collected in the zone. *Harleya oxylepis*, *Justicia comata*, *Panicum boliviense* (1474), and *Panicum trichanthum* are additional species often characterizing the habitat.

The banks of the river above El Paso are low on both sides so that they are often flooded for weeks during the wet season. The heavy black alluvial soils are continuously saturated, even during the dry season. The trees fringing the river range in height from 8 to 20 meters; they include *Inga edulis* (Lundell 1505), *Coccoloba schiedeana* (1498), *Capparis tuerckheimii* (1499), *Lonchocarpus hondurensis* (1470, 1479, 1521, 1612), *Pithecolobium latifolium* (1497), and *Bucida buceras*. The shrub, *Clerodendron ligustrinum*, grows densely along the banks which are not too shaded.

Under the trees fringing the stream, and extending for as much as 100 meters inland across the low flood plain, the stands of the *jauacte* palm, *Bactris* sp. (Lundell 1522), dominate the undergrowth. The trunk, leaves, and inflorescence of the palm are densely armed with hard, long, needle-pointed spines. It ranges in height from 2 to 5 meters, and grows so thickly that it is difficult to penetrate an area it occupies. This understory subassociation is known as the *jauactal*. Inland from the *jauactal*, I encountered the *botanal* which through transition stages merged into the *caobal* on higher banks.

About 10 leagues below El Paso near the place called La Pava, *Clerodendron ligustrinum* (Lundell 1472) and three species of treelets, *Ouratea jurgensenii* (1473), *Ouratea* sp. (1477), and *Rhacoma riparia* (1476), are common on the low, muddy, saturated banks behind which extends an extensive *akalche*.

As around the lakes, the slope of the bank largely determines the associations. The intermediate stages through which the transition from the river vegetation to the climax forest progresses have not been fully investigated, but in general they are much like those previously described (Lundell, 1934b, p. 270).

In the drainage system of the San Pedro de Martir River numerous *arroyos* are found which during the dry season are reduced to a series of unconnected pools. Near Kantetul on the banks of one of these *arroyos* I collected the *ixtze*, *Lonchocarpus hondurensis* (Lundell 3163), and the *chiquax*, *Cordia diversifolia* (3165), the former a tree about five meters high and the latter an erect shrub about four meters high.

In northeastern Petén the *bambonal* and *arenal* associations were encountered by Bartlett (1935b, p. 24) along streams. The former, characterized by a dense growth of the bamboo, *Guadua* (?), occurs on banks. The *arenal* is an association

of sandy beds in dry *arroyos* where species of *Xanthosoma*, *Ageratum*, *Acalypha*, grasses, sedges, etc., are most prominent.

In the following systematic list all the hydrophytic and riparian species are included which the writer collected or noted along streams in Northern Petén.

## TREES:

- |              |  |
|--------------|--|
| Polygonaceæ  | <i>Coccoloba schiedeana</i> Lindau. 1498.  |
| Capparidaceæ | <i>Capparis tuerckheimii</i> Donn. Sm. 1499.   |
| Leguminosæ   | <i>Inga edulis</i> Mart. 1505.   |
|              | <i>Lonchocarpus hondurensis</i> Benth. <i>Ixtzente</i> . 1470, 1479, 1521, 1612, 3163. |
|              | <i>Pithecolobium latifolium</i> (L.) Benth. 1497.                                      |
| Combretaceæ  | <i>Bucida buceras</i> L.   |

## SHRUBS OR TREELETS:

- |             |  |
|-------------|--|
| Palmæ       | <i>Bactris</i> sp. <i>Jauacte</i> . 1522.                |
| Celastraceæ | <i>Rhacoma riparia</i> Lundell. 1476.                    |
| Ochnaceæ    | <i>Ouratea jurgensenii</i> (Planch.) Engl. 1473.         |
|             | <i>Ouratea</i> sp. 1477.                                 |
| Boraginaceæ | <i>Cordia diversifolia</i> Pavon. <i>Chiquax</i> . 3165. |
| Verbenaceæ  | <i>Clerodendron ligustrinum</i> (Jacq.) R. Br. 1472.     |

## HERBS:

- |               |   |
|---------------|---|
| Salviniaceæ   | <i>Salvinia auriculata</i> Aubl. 1565.                    |
| Gramineæ      | <i>Panicum boliviense</i> Hack. 1474.                     |
|               | <i>Panicum trichanthum</i> Nees.                          |
| Cyperaceæ     | <i>Cladium jamaicense</i> Crantz. <i>Saibal</i> .         |
|               | <i>Cyperus diffusus</i> Vahl. 1475.                       |
|               | <i>Eleocharis caribæa</i> (Rottb.) Blake. 2152.           |
| Pontederiaceæ | <i>Pontederia lanceolata</i> Nutt. 1445.                  |
|               | <i>Pontederia rotundifolia</i> L. 1564.                   |
| Amaranthaceæ  | <i>Alternanthera obovata</i> (Mart. & Gal.) Standl. 1507. |
| Nymphaeaceæ   | <i>Cabomba aquatica</i> Aubl. 1502, 2198.                 |
|               | <i>Nymphaea ampla</i> (Salisb.) DC. 1517.                 |
| Acanthaceæ    | <i>Justicia comata</i> (L.) Lam.                          |
| Compositæ     | <i>Egletes viscosa</i> (L.) Less. 1543.                   |
|               | <i>Harleya oxylepis</i> (Benth.) Blake. 2197.             |
|               | <i>Spilanthes americana</i> (Mutis.) Hieron. 1449.        |

## Aguadas (SINKHOLES) AND BANKS

*Aguadas*<sup>1</sup> (sinkholes) in the under-drained uplands, usually oval in shape and varying greatly in size and depth, form a distinctive habitat. Water stands in some more or less permanently, in others only during the rainiest months. Their soils are heavy, impervious, acid clays. Those which hold water for long periods have characteristic hydrophytic associations, which, except for limitations due to size of the basins, resemble closely those of lakes. The aquatic vegetation varies greatly, for one or two species may dominate in one pond and be entirely absent or inconspicuous in another.

Some *aguadas* covered by a floating association of *Pistia stratiotes* are called *lechugales* (Plate 15). In other places *Lemna* and *Wolffia* species may be present to form a continuous covering of the surface. In such sinkholes, few, if any, of the submerged aquatics can exist. However, around the edges thrive sedges rang-

<sup>1</sup> The water-holes in the *bajos* are also called *aguadas*. For a discussion of them, refer to page 27.

ing from small filiform species of *Eleocharis* and *Cyperus* to the giant *Cladium jamaicense*.

In ephemeral *aguadas* the entire flooded basin often is overgrown with *Chara* and *Nitella*. In other sinkholes not densely covered by the floating species, *Cabomba aquatica* may appear as well as *Potamogeton lucens*.

In Southwestern and Southern Campeche (see Lundell, 1934b, pp. 277 and 300) I found ponds with margins characterized by a thick growth of *Echinodorus*, others by shrubby aquatics, *Æschynomene hispida* and *Mimosa pigra*.

In the large *aguada* at San Felipe, Campeche, and in another near Chuntuqui, Petén, the giant sedge, *Cladium jamaicense* (Lundell 1439), dominates. A small sinkhole near El Paso, which holds water for short periods, is overgrown with *Heliconia*.

Often, when the *aguadas* are small, they are completely shaded by the forest surrounding them. In such instances, the microscopic flora may be most prominent, as is evidenced by the green color and scummy surfaces.

If the banks are steep, the hygrophilous tree genera, *Ficus* and *Bucida*, may dominate. *Pachira* occurs on swampy margins. On the wet banks of the *aguada* at San Felipe, Campeche, *Tabernaemontana chrysocarpa* (Lundell 1444), a tree 5 to 8 meters high, was common. *Aguada Tigre* on the Yaxha-Remate trail is surrounded by a *corozal*, a dense grove of the giant *corozo* palm, *Orbignya cohune*. In other places the low bank may be covered with a large stand of the *botan* palm, *Sabal* sp., giving the *botanal*.

Unknown edaphic influences doubtlessly account for many of these localized aquatic and bank associations.

In general the transition from the *aguada* associations to the climax upland forest is rapid, for most of the banks rise at a steep angle.

#### WOODED SWAMPS (*Bajos*)

In the broad, flat, subsidence basins (Sapper, 1898) of Northern Petén lie the extensive wooded swamps known as *akalches* in Maya and *bajos* in Spanish. In these same troughs are found Lake Petén, Lake Yaxha, Laguna Perdida, and numerous other bodies of water. Apparently the *akalche* areas were once shallow lagoons which have been silted through the erosion of the uplands and now lie above the ground-water table during the dry season (see Cooke, 1931).

Water stands over the *bajos* for long periods during the rainy months; in the dry season it generally evaporates except in the unsilted depressions near their centers where small pools remain. These pools (*aguadas*) are analogous to such bodies of water as Lake Yaxha and Laguna Perdida, which are gradually being reduced in size through silting and encroachment of vegetation.

The water which periodically floods the *akalche* basins is coffee-colored, containing a high percentage of decomposing organic matter. The same is true of the water in the upland *aguadas* and many of the streams.

The plant growth in the *akalches* is that of a mixed forest, strikingly different from the upland mesophytic forest, both in floristic composition and physiognomy. The contrast is almost as great as between the mangrove swamp growth and that of the upland rain-forest.

That the vegetation in the wooded swamps suffers from moisture deficiency during the dry season appears probable. Surface water evaporates, and that remaining in the heavy, acid, *glei* soils is probably in a hygroscopic state, hence not available to plant life. This moisture deficiency, even though only for a short period each year, may account for the xerophytic conditions. Other important factors influencing the vegetation are acidity, poor aeration of the soils, intense insolation, and the periodical flooding. The species must be highly adaptive to survive.

In the middle of the *akalches* around the pools (*aguadas*), the vegetation is generally reduced to an association of saw-toothed sedges and low, shrubby species. Progressing from the center outward, the height of the swamp growth increases and gradually, corresponding with better drainage conditions, becomes more mesophytic in nature as the forest of the well-drained uplands is approached.

If *aguadas* are present, they are often covered with a floating mass of *Pistia stratiotes*, hence termed *lechugales*. In some basins sedges thrive in the shallow water, species of *Eleocharis* being commonest. On the saturated mud banks of an *aguada* in the *bajo* north of Naachtun, *Eleocharis retroflexa*, *Fuirena simplex*, *Rynchospora cephalotes*, and *R. cyperoides* predominate.

The basins in the centers of the *bajos* are sometimes called *tembladera* according to Bartlett (1935b, p. 23). In such cases the *aguadas* are fringed by the *zapotebobo* tree, *Pachira aquatica*, thus giving the *zapoteboba* as the marginal association. The writer encountered a *zapoteboba* in the savanna country (see p. 115). It is also said that the *julub* tree (unidentified) may be dominant, giving a *juluba*.

Often the pools are fringed by the *palo tinta* tree, *Hæmatoxylum campechianum* (Lundell 1566), from which the *tintal* association derives its name. The association characterized by *Hæmatoxylum campechianum* is most prominent in the majority of *akalches* (Plate 16). The *tintal* may be several kilometers in width; it covers the broad central area of the wooded swamps, and therefore merits detailed description (see Plate 14).

In general the height of the greater part of the *tintal* varies from 5 to 11 meters with the height increasing away from the center. However, in the uppermost tier, there are a few large erect trees which tower much higher, standing out as sentinels above the mass of the swamp forest. Such a tree is *Talisia floresii* (Lundell 3185), a species reaching a height of 20 meters. Curiously the tree also occurs in the mesophytic forest, hence being adapted to two diverse habitats.

Below lies the main tier to which the mass of the *akalche* mixed forest belongs. Here are found the low trees and shrubs, *Hæmatoxylum campechianum*, *H. brasiletto*, *Diospyros bumelioides*, *Guettarda gaumeri*, and various species of *Eugenia*, *Hyperbæna*, *Coccoloba*, *Mimosa*, *Croton*, *Cæsalpinia*, *Phyllanthus*, *Psychotria*, and *Xylosma*. In individuals the Leguminosæ and Euphorbiaceæ appear to dominate.



The trees and shrubs are gnarled, twisted, thorny, with interlocked knotty branches. Some, such as *Hæmatoxylum campechianum*, are shaggy-barked and deeply grooved. Very few are erect; many have distorted trunks and branches disproportionately large. The leaves are thick, hard, glossy or glaucous, generally small or pinnately compound. All protective devices against intensive insolation and excessive evaporation are present.

The height of the tier varies so that it may be considered entirely as composed of shrubs in some spots, yet the same species are of tree size in other areas. No small shrubs have been collected and few exist, for the water often rises to a depth of from 1 to 3 meters during the flood period.

Grotesque, twisted, knotty lianas abound. Most are very thick, ascending by broad loops or lying piled on the ground. Even though the swamp forest is low, some of the lianas reach a diameter of from 10 to 20 centimeters. Many contain water which serves as a refreshing drink to the collector struggling through the distorted mass. Smaller vines, mostly suffrutescent, are present. I collected *Vincetoxicum lundellii* (Lundell 1518) and *Urechites andrieuxii* (1524) in the swamps.

The herbaceous growth is scant and chiefly sedgy. It is restricted mostly to coarse saw-toothed cutting sedges such as *Scleria bracteata*, a species growing from 1 to 3 meters high and forming an intertwined growth that can be penetrated only with pain and difficulty. *Rynchospora cephalotes* (Lundell 1440, 3164), a sedge scarcely exceeding 1 meter in height, is widely distributed in the areas, but not growing densely as *Scleria bracteata*. *Cyperus virens* (1606) is occasionally encountered. In an *akalche* on the banks of the San Pedro de Martir River near La Pava scattered individuals of the composite, *Harleya oxylepis*, are present.

In the dry season, open areas such as trails become overgrown by grasses and annuals of which *Egletes viscosa* and *Spilanthes americana* are typical.

Epiphytes cover such trees as *Hæmatoxylum campechianum*, attaching themselves in the deep grooves and to the branches. Among the epiphytes, the Bromeliaceæ, *Tillandsia* and *Æchmea*; the scandent fern, *Polypodium palmeri*, and *Polypodium phyllitidis*; and orchids of such genera as *Polystachya*, *Trigonidium*, *Oncidium*, *Pleurothallis*, *Epidendrum*, and *Maxillaria* are commonest. Aroids are rare. Bryophytes are very abundant.

The *tintal* association does not dominate the central area in all wooded swamps, although it characterizes the majority. Other associations characterized by the *chechem*, *Metopium brownei*, and other species were noted in the preliminary survey, but it was not possible at the time to study them. The exploration of the uninviting yet interesting swamps will repay in discoveries all effort devoted to them.

The *tintal*, and other edaphic climax associations of the central area of the *bajos*, intergrade on better-drained soils into the palm associations of the transitional zone.

The transitional zone lies between the lower central area of the *bajos* and the well-drained uplands (see Plate 14). It is characterized by two edaphic climax

palm associations, the *escobal* and *botanal*. Although the *escoba* palm, *Cryosophila argentea*, and the *botan*, *Sabal* sp., both occur commonly in the well-drained uplands, they are not so prominent there, relatively speaking. In the *escobal* and *botanal* these palms generally overtop the other vegetation and dominate in number of individuals, forming veritable groves (Plate 17).

The *escobal* typifies areas only slightly less swampy than the central zone (*tintal*, *chechemal*) of the *akalches*. Apparently the land where the association occurs is subject to less inundation, although the soil remains saturated the greater part of the year. In the *escobal* lying between the village of Yaxha and Ixtinto, small *arroyos* and seeps are interspersed through the area. The greater part of the growth is made up of stunted, gnarled trees, coiled lianas, and epiphytes such as are found in the *tintales*. The height of the forest of this particular swamp only slightly exceeds that of the *tintal* zone. The *escobal* may well be considered a phase of the *akalche* in which the palm is possibly indicative of different edaphic conditions.

Mosses and liverworts abound in the *escobal* near the village of Yaxha, being more abundant there than in any other area I have visited in the region (see Steere, 1934).

On somewhat higher, better-drained ground the *botan* palm thrives, giving the *botanal*, a mixed forest association from 15 to 25 meters in height in which the *botan* palms form the uppermost tier. Stunted trees of such species as *Achras zapota*, *Swietenia macrophylla*, and *Metopium brownei* may be quite prominent. *Sabal* sp. occurs locally in almost pure stands. *Botanales* are found on the banks of *aguadas* and lakes where soil conditions are favorable.

The relative physiographical positions of all the wooded swamp associations are shown in the diagrammatic cross-section, Plate 14.

Although the following systematic list does not approach completeness, it includes the characteristic species in the wooded swamps of Northern Petén. The *bajos* have not been thoroughly explored, hence many of the swamp-inhabiting species have not been collected.

#### TREES:

Palmæ	<i>Sabal</i> sp. <i>Botan</i> .
Fagaceæ	<i>Quercus oleoides</i> Cham. & Schl. var. <i>australis</i> Trel. Bartlett 12112.
Ulmaceæ	<i>Celtis hottlei</i> Standl. Luin. Bartlett 12532.
Leguminosæ	<i>Albizzia</i> (?). <i>Hæmatoxylum brasiletto</i> Karst. <i>Hæmatoxylum campechianum</i> L. <i>Palo tinta</i> . Lundell 1566; Bartlett 12698. <i>Lonchocarpus guatemalensis</i> Benth. <i>Ixec subin</i> . Bartlett 12506, 12571, 12573. <i>Lonchocarpus hondurensis</i> Benth. <i>Ixtzente</i> , <i>Ciicche</i> . Bartlett 12239, 12454.
Meliaceæ	<i>Swietenia macrophylla</i> King. <i>Caoba</i> .
Euphorbiaceæ	<i>Croton reflexifolius</i> HBK. Bartlett 12103, 12697.
Anacardiaceæ	<i>Metopium brownei</i> (Jacq.) Urban. Bartlett 12695.
Sapindaceæ	<i>Cupania belizensis</i> Standl. Bartlett 12457. <i>Talisia floresii</i> Standl. Poloc. Lundell 3185.

Bombacaceæ	<i>Pachira aquatica</i> Aubl. Zapotebobo.
Combretaceæ	<i>Bucida buceras</i> L.
Sapotaceæ	<i>Achras zapota</i> L. Chicozapote, Zapote.
Apocynaceæ	<i>Aspidosperma cruentum</i> Woodson.
Solanaceæ	<i>Cestrum panamense</i> Standl. Bartlett 12743.

## SHRUBS AND TREELETS:

Palmae	<i>Cryosophila argentea</i> Bartlett. Escoba.
Polygonaceæ	<i>Coccoloba reflexiflora</i> Standl.
Annonaceæ	<i>Guatteria leiophylla</i> (Donn. Sm.) Saff.
Capparidaceæ	<i>Capparis cynophallophora</i> L.
Leguminosæ	<i>Bauhinia jenningsii</i> P. Wilson. Ixacitz. Bartlett 12145. <i>Mimosa hemiendyta</i> Rose & Robins.
Ochnaceæ	<i>Ouratea jurgensenii</i> (Planch.) Engl. Ixpambul. Bartlett 12240.
Myrtaceæ	<i>Eugenia lundellii</i> Standl.
Melastomataceæ	<i>Miconia ambigua</i> (Humb. & Bonpl.) DC.
Myrsinaceæ	<i>Ardisia escallonioides</i> Schl. & Cham.
Ebenaceæ	<i>Diospyros bumelioides</i> Standl.
Rubiaceæ	<i>Guettarda gaumeri</i> Standl. <i>Psychotria flava</i> CErst. <i>Psychotria fruticetorum</i> Standl. <i>Psychotria undata</i> Jacq. Bartlett 12244.
Compositæ	<i>Eupatorium macrophyllum</i> L. <i>Vernonia aschenborniana</i> Schauer. A scrambler.

## LIANAS:

Palmae	<i>Desmoncus uaxactunensis</i> Bartlett.
Dioscoreaceæ	<i>Dioscorea bartlettii</i> Morton. Cocomeca blanco. Bartlett 12140.
Polygonaceæ	<i>Gymnopodium antigonoides</i> (Robinson) Blake.
Leguminosæ	<i>Bauhinia glabra</i> Jacq. Bartlett 12455.
Malpighiaceæ	<i>Hiræa obovata</i> (HBK.) Ndzu. Bartlett 12696.
Sapindaceæ	<i>Paullinia fuscescens</i> HBK. Bartlett 12458. <i>Serjania adiantoides</i> Radlk. Bartlett 12102. <i>Serjania scatens</i> Radlk. Bartlett 12104.
Loganiaceæ	<i>Strychnos panamensis</i> Seem. (?). Bartlett 12456.
Rubiaceæ	<i>Morinda yucatanensis</i> Greenm.

## SUFFRUTESCENT AND HERBACEOUS VINES:

Passifloraceæ	<i>Passiflora biflora</i> Lam. Xicotz, Ala de murcielago. Bartlett 12510. <i>Passiflora palmeri</i> sublancoolata Killip.
Apocynaceæ	<i>Urechites andrieuxii</i> Muell. Arg. Lundell 1524.
Asclepiadaceæ	<i>Vincetoxicum lundellii</i> Standl. Lundell 1518.

## HERBS:

Polypodiaceæ	<i>Pityrogramma calomelæna</i> (L.) Link. Bartlett 12113.
Gramineæ	<i>Panicum trichanthum</i> Nees. Bartlett 12245.
Cyperaceæ	<i>Cyperus virens</i> Michx. Lundell 1606. <i>Eleocharis retroflexa</i> (Poir) Urban. <i>Fuirena simplex</i> Vahl. <i>Rynchospora cephalotes</i> (L.) Vahl. Lundell 3164. <i>Rynchospora cyperoides</i> (Sw.) Mart. <i>Scleria bracteata</i> Cav. <i>Pistia stratiotes</i> L. Lechuga.
Araceæ	<i>Waltheria americana</i> L. Bartlett 12114.
Sterculiaceæ	<i>Hydrolea spinosa</i> L. Bartlett 12368.
Hydrophyllaceæ	<i>Borreria verticillata</i> (L.) Mey. Bartlett 12105.
Rubiaceæ	<i>Geophila herbacea</i> (Jacq.) Schum. Bartlett 12530.
Compositæ	<i>Egletes viscosa</i> (L.) Less. Bartlett 12132. <i>Eupatorium odoratum</i> L. Bartlett 12101. <i>Harleya oxylepis</i> (Benth.) Blake. Lundell 1533.

*Perymenium peckii* Robins. Bartlett 12110.  
*Wedelia adhærens* Blake. Bartlett 12111.  
*Wedelia parviceps* Blake. Bartlett 12108.  
*Zexmenia serrata* Llave. Bartlett 12235.

## EPIPHYTES:

Polypodiaceæ	<i>Polypodium palmeri</i> Maxon. <i>Polypodium phyllitidis</i> L. Bartlett 12148.
Hymenophyllaceæ	<i>Trichomanes godmani</i> Hook. Bartlett 12249. <i>Trichomanes krausii</i> Hook & Grev. Bartlett 12531; Lundell 2054.
Bromeliaceæ	<i>Tillandsia valenzuelana</i> A. Rich. Bartlett 12147.
Orchidaceæ	<i>Brassia maculata</i> R. Br. Bartlett 12699. <i>Epidendrum cochleatum</i> L. Bartlett 12742. <i>Sarcoglottis picta</i> (Anders.) Kl. Bartlett 12119.
Piperaceæ	<i>Peperomia polochicana</i> Trel. Bartlett 12150. <i>Peperomia quiriguana</i> Trel. Bartlett 12149.

## Corozales

The *corozo* palm, *Orbignya cohune*, grows in great groves giving the association known as the *corozal*. The palm with its towering straight trunk crowned with huge pinnate leaves ascending in great arches is a tree of unsurpassed beauty and gracefulness. Another palm of similar appearance, *Scheelea lundellii* (see p. 142), may be of first importance in the association. The subdominants are great trees, *Achras zapota*, *Swietenia macrophylla*, and species of *Ficus*.

*Corozales* are found along river banks, in valleys, and occasionally on hill sides, habitats where the soils are deep and fairly well drained. The association is one of the best defined of any of the uplands.

The exact relationship of the *corozal* to the climax associations has not been definitely determined. I am of the opinion that the *corozal* represents an intermediate stage because of its requirements of deep, moist, fairly drained soils, edaphic conditions which are limited chiefly to gentle hill slopes, valleys, and stream banks.

## CLIMAX FORMATION

The climax broad-leaved forest found on the uplands of Northern Petén is most luxuriant in the zone extending east and west between the Paixban River and the San Pedro de Martir River (Plate 1). In broad well-drained valleys and on the gently undulating areas the trees of the uppermost tier attain a maximum height of about 50 meters, while on hill tops the bush may be reduced to low mesoxerophilous forest not exceeding 20 meters in height. Much of the forest may be classed as closed. A majority of the species are evergreen.

Where the forest reaches its maximum height it sometimes forms a canopy through which little sunlight filters; hence the undergrowth is scant. Tree trunks in forest of this type give the interior an appearance of columned halls. Giant lianas irregularly ascend the trees unincumbered by epiphytes. The floor is a soft mass of decaying leaves over which one may ride unhindered on horseback. However, if a tree has died or fallen, enabling sunlight to reach the floor, a patch of green luxuriant growth breaks the monotony of the golden brown tints of the fallen leaves.

Forest with abundant undergrowth is much commoner, and there are of course all intermediate phases. The underwood, lianas, herbs, and epiphytes grow so densely in places that one must laboriously cut a way through.

Along rivers and fringing margins of openings every inch of space is occupied by a dense growth of trees, shrubs, and herbs. Vines may cover entire trees. A massive wall of green veils the forest of the hinterland. Therefore an adequate concept of the general appearance of the rain-forest can be obtained only by an artificial side view such as is afforded by a recent clearing (Plate 18, fig. 1).

From an artificial cut Schimper (1903, p. 286) aptly describes the rain-forest. It is an irregularly jagged, crested, and furrowed mass in which the prominence of tiers, the great diversity of tree trunks, the irregular tangle of lianas, and the variety in the forms of the foliated crowns are the outstanding features.

In the Northern Petén quasi-rain-forest several hundred tree species are represented, most of which are widely and evenly distributed. Forest giants do not average more than two or three to the acre. The majority of the trees are erect, tall, and exceedingly slender in proportion to height. One of the giants is the mahogany, *Swietenia macrophylla*, which reaches a diameter of three meters. It and species of *Ficus* are characterized by immense plank buttresses some of which are so large that a man on a mule may easily hide between them. *Achras zapota* has large rounded supporting roots extending aboveground around the base of the tree, serving the same purpose as plank buttresses. The *ramon*, *Brosimum alicastrum*, has low thick buttresses.

It may be of significance to point out that buttresses are of survival value in the forests of the Yucatan Peninsula because of the physical support they afford. The soils of the uplands are very shallow and winds topple the trees easily. Buttresses may account in part for the prominence of the *caoba*, *ramon*, and *zapote*, the species which characterize the major climatic climax associations in the Northern Petén forest.

The bark of the trees is exceedingly variable. It is thin and relatively smooth, often greenish, on species of the Leguminosæ and *Ceiba*. *Bursera simaruba* and *Pimenta officinalis* have papery bark which peels off in thin sheets. The former species is red in color and the latter white, both very distinctive. The bark of many apocynaceous trees is soft, unfissured, slightly rough, and generally tan in color. That of *Brosimum alicastrum* is very hard and brittle, scaling off to leave a somewhat irregular gray and white splotched surface (see Plate 3, fig. 1). The bark of some trees, species of *Lucuma* and *Sideroxylon* among them, is thin and shreddy, somewhat powdery when crushed. On the other hand, that of species of *Achras*, *Swietenia*, *Dipholis*, and numerous other trees is thick, rough, deeply fissured.

The trunks of many trees such as species of *Lucuma* and *Pimenta officinalis* are grooved, fluted, and highly irregular. In the slightly asymmetrical class I place the *ramon*. The *Ceiba*, *Cryosophila*, various leguminous trees, and other species are thorny. Laticiferous trees are common.

By such characters alone the natives distinguish species and even varieties. Although the time I have spent in the forests of the Yucatan Peninsula is relatively short, I am able to spot all the commoner trees in the same manner. This has been an invaluable aid in distinguishing the complex forest associations. An important phase of study in the future will be the recognition of those characters which are sufficiently distinct to be of value both to taxonomists and ecologists. I urge the study upon ecologists as an aid in the classification of the associations of tropical rain-forests where it is almost impossible to obtain adequate herbarium material. It is noteworthy that folk names are often based on these grosser characters.

In the dense rain-forest, branches are few and irregular, ascending at a steep angle, becoming complicated only near the margins of the crowns. The palms are of course unbranched. *Cecropia* and certain species of the *Araliaceæ* have only a few main branches which produce only a few simple axes at the tips of which are borne the leaves and inflorescences. Branching in many species is distinctive.

The crowns of rain-forest trees have been classed as umbrella-shaped, oval, candelabra-shaped, and irregular. In Northern Petén the oval, candelabra-shaped, and irregular types predominate.

In the lower shaded areas the leaves are often large and membranaceous, while in the upper tiers they are small, firm, leathery, and glossy, the general type designated as lauraceous. Some are coarsely pinnate. On the same tree the leaves vary greatly from the base to the summit of the crown, decreasing in size as the top is approached. Intense insolation and evaporation in the upper tiers necessitate protective structures and reduction in leaf size. *Achras zapota* and many other species have their leaves aggregated in rosette-like tufts at the ends of the twigs.

Shrubs grow densely in favorable spots. Scarcely anywhere does there exist an area where scattered underwood is not present. The species of *Piper*, distinguished by their enlarged nodes, form the largest group both in species and individuals. Species of the *Rubiaceæ*, chiefly *Psychotria*, rank next in abundance. In general the shrubs are sparsely branched and the crowns are quite irregular.

Along with the dicotyledonous shrubs appear the low palms, among them the numerous seedlings of *Cryosophila*, *Opsiandra*, and species of *Chamædorea* and *Bactris*. They form an outstanding element of the taller shrub tier over wide sections.

Lianas are conspicuous. The large woody forms are represented commonly by species belonging to the *Bignoniaceæ* and *Malpighiaceæ*. The only way to obtain adequate herbarium material of them is by felling the forest, for their leaves and inflorescences are borne in the tops of the highest trees. This difficulty has up to now delayed the identification of some of the species.

Outstanding among the lianas of the forest of the southern half of the Yucatan Peninsula are the scrambling spiny palms, species of *Desmoncus*. The woody bamboo, *Arthrostylidium pittieri*, another scrambler, forms dense impenetrable thickets as much as five meters in height.



Among the fleshy high-climbing vines appear species of *Vanilla*, and the exceedingly fragrant-flowered *Neodonnellia grandiflora*.

Apparently the distribution of the herbs is more dependent upon light than upon other factors. Moisture is plentiful the greater part of the year. As botanists have previously observed in rain-forests, herbs are sometimes encountered in extensive patches, the composition of each one of which may be limited to a few species.

Probably the most conspicuous epiphytes of the humid shaded zone are the giant root-climbing aroids, species of *Monstera* and *Philodendron*. They completely surround tree trunks and extend from the tree bases to the crotches. Some of their leaves may reach a length of a meter or more. Even more striking than these are the root-climbing cacti appropriately called "devil's guts" by the creoles of British Honduras. Some form immense tangled masses on the trunks and larger branches, others extend up the stems as irregular strands. Species of *Cereus*, *Rhipsalis*, and *Deamia* are among those represented.

Wherever a little humus accumulates, in hollows, in grooves of the trunks, or on the large branches, other epiphytes grow in profusion. The hemi-epiphytic species of *Ficus* start their growth from such spots, send down their roots to the earth, then gradually encase their host in what Schimper (1903, p. 292) graphically calls the "living coffin within which many a stately tree moulders away" (see Plate 19). Ferns and orchids grow in the scant humus or form nest epiphytes. The Bromeliaceæ appear as tank epiphytes. Mingled with these appear the fleshy scandent species of *Peperomia*.

Trunks of some palms are covered entirely with ferns, chiefly species of *Nephrolepis*, others support a growth of mosses. The thorny expanded bases of *Cryosophila argentea* sometimes are green with a covering of *Trichomanes*. Some trees are almost free from epiphytes, others are so weighted down that their branches break under the load. Often entire trunks not supporting other growth are covered by mosses and liverworts. The leaves are often covered with minute liverworts, lichens, and algæ.

Above the humid zone of the inner forest, up in the exposed crowns of the trees, grow such xerophilous epiphytes as tank types of bromeliads belonging to the genera *Tillandsia* and *Æchmea*. In the crowns are encountered the species of *Phoradendron*, the most common parasites.

The greater portion of the climax forest of Northern Petén is composed of three major tree associations: (1) the *ramonal*, characterized by groves of the *ramon*, *Brosimum alicastrum*; (2) the *caobal*, typified by the *caoba* (mahogany), *Swietenia macrophylla*; and (3) the *zapotal*, dominated by the *zapote*, *Achras zapota*. The *zapote* and *ramon* appear in all three associations, therefore the degree of dominance is the criterion to be used in distinguishing the associations from each other. Bartlett (1935b, pp. 17 and 18) has recognized five additional associations (*uacutal*, *cedral*, *manaxal*, *higueral de las ruinas*, and *pedregal*) in the climax formation, and there are probably others. The physiographical position of the climax formation is shown in the diagrammatic cross-section of Northern Petén, Plate 14.

*Ramonal*—The distribution of certain species in Northern Petén possibly is due more to man's influence than to edaphic differences, for the *rendzina* soils appear much the same throughout the uplands. I am personally convinced that the groves of the *ramon*, *Brosimum alicastrum*, on old Maya sites, are there largely because the Maya Indians planted the tree, thus giving the species an advantage which it has been able to maintain against all competition (see p. 10).

Although transect counts have not been made, I estimate that there are as many as one hundred trees of this species per acre in some groves (see Plate 3). The *ramonales* are virtually forests of one species, yet trees of the *caobal* and *zapotal* are not excluded. *Brosimum alicastrum* is comparatively fast growing; I conjecture from information obtained concerning ages of trees planted in present villages that it reaches a height of 20 meters in about 50 years.

As in all the rain-forest, there are a number of tiers, the uppermost of which towers as much as 15 meters above the general mass. The *caoba*, *Swietenia macrophylla*, and species of *Sideroxylon* and *Ficus* have been observed as among the outstanding of what may be termed the forest sentinels.

To the middle tree tier, which forms the mass of the forest canopy, belong the dominant *ramon*, the *zapote*, *Achras zapota*, the *guayo*, *Talisia olivæformis*, and many other species not yet collected.

The lower tier consists of smaller trees including *Celtis trinervia* (Lundell 4306), *Ocotea lundellii* (4359), and several palms among which *Opsiandra maya* is notable because of the fact that it is generally encountered on Maya ruins in *ramonales*. It occurs elsewhere, however, on bluffs and along water courses.

The woody vines are chiefly species of Bignoniaceæ. They climb into the tops of the tallest trees, and it is impossible to make collections without felling the forest. I collected the new *Clytostoma mayanum* (Lundell 4007) in the *ramonal* at Ixlu.

The ruins of Naachtun are partly overrun by a dense bamboo thicket of the scandent *carrizo*, *Arthrostylidium pittieri* (Lundell 1140).

Below in the shadow of the forest is a tier of large shrubs among which are *Piper colaphitolerans* (Lundell 3827), *Piper sempervirens* (3828), *Guatteria leiophylla* (1157), *Hybanthus yucatanensis* (4307), and *Forchammeria trifoliata* (1159), known as *tres Marias*. In the *ramonales* covering the ruins of Ixlu and Naachtun, the *Piper* shrubs dominate the underwood, making up the greater number of species and individuals. On the sites of ruins, undergrowth palms rank next to *Piper* in importance, species of *Chamædorea* being commonest.

Herbaceous growth is present, but I collected only one species at Naachtun, the low, subscandent, succulent *Dichorisandra hexandra* (?) (Lundell 1141) which grew in a patch beside the trail where sunlight filtered through.

On tree trunks in the humid lower zone grew the orchids, *Pleurothallis* sp. (Lundell 1158), *P. stenostachya* (1156), *Notylia trisepala* (3899), *Ionopsis utricularioides* (3898), and the root-climbing aroid, *Anthurium æmulum* (1160). On a

branch of a tree of the upper tier in the *ramonal* at Topoxte, I collected one of the tank epiphytes, *Tillandsia balbisiana* (3960).

On trees with rough and fissured bark, mosses and liverworts often cover the trunks. The smooth trees, the type to which the *ramon* belongs, are almost devoid of such growth.

*Caobal*—Unlike the *ramon* and *zapote*, the *caoba*, *Swietenia macrophylla*, does not occur in groves. It is rare to find as many as half a dozen mahogany trees on an acre. One or two giants to the acre is an unusual condition. A giant of the species is so striking as it stands among hundreds of towering slender-stemmed trees that it is not difficult to see why natives are impressed by it to the extent that areas are designated as *caobales*. *Swietenia macrophylla* is never a dominant. The *caoba* towers above all other trees of the forest, a fact of importance in logging operations, for scouts may climb to a point which commands a view of the forest to locate the giants (Plate 18, fig. 1).

The *caoba* thrives in deep soils of gentle slopes and well-drained valleys. It is very prominent in all *corozales*. In Northern Petén I encountered *caobales* chiefly in the broad well-drained valleys.

Where exploitation of the sapodilla forests, continued over a long period, has eliminated the *zapote* trees, the *caoba* often remains as the most conspicuous tree of economic value. Such culled areas are often termed *caobales*.

Until more intensive surveys are undertaken, I will not attempt to give a detailed discussion of the association. It very closely resembles the *zapotal* in floristic composition and physiognomy, and may be considered a phase of the *zapotal*.

*Zapotal*<sup>1</sup>—The *zapote*, *Achras zapota*, thrives on the shallow soils of the uplands. Either through an advantage accruing to it from protection by the Maya, or through its tolerance, aggressiveness, and longevity the species has become dominant, forming a great forest (see p. 10).

The species has considerable adaptability; it is present in exposed habitats (hill caps and *sequelar*), rain-forest, and in the better-drained sections of the wooded swamps.

At least 75 per cent of the upland forest of Northern Petén may be classed as a *zapotal*. As many as twenty large sapodillas per acre may be found in some areas; the general average is not less than six large trees per acre.

In the uppermost tier of the *zapotal* appear the *Santa Maria*, *Calophyllum brasiliense* var. *rekoi*, the *caoba*, *Swietenia macrophylla*, *Rheedia edulis*, *Lucuma campechiana* (Lundell 3948), *Sideroxylon amygdalinum*, and species of *Ficus*. The list of species of the upper tier will be extended considerably as exploration progresses. It is extremely difficult to obtain herbarium material, as most of these trees are too large to climb.

<sup>1</sup> Bartlett (1935b) has designated the entire climax formation as a *zapotal* with the *ramonal*, *caobal*, etc., as phases of it whereas in this report I classify all the associations, including the *zapotal*, as phases of the climax vegetation. The *zapotal* is by far the most important association and may be considered as typifying the upland forest (see Lundell, 1934b, pp. 278 and 279).

To the middle tier of trees belong the dominant *zapote*, *Achras zapota*, the *yaxnic*, *Vitex gaumeri* (Lundell 1509), *Ficus radula* (3181), *Ficus ærstediana* (2200), *Cecropia mexicana*, *Bursera simaruba*, *Spondias mombin*, *Aspidosperma megalocarpon*, the *ramon*, *Brosimum alicastrum*, the *manax*, *Pseudolmedia spuria*, and species of the Lauraceæ and Leguminosæ.

The lower tree tier is outstanding in the areas of somewhat open forest. Many of the species of low trees average about 10 meters in height. In one locality the tier may not exceed 8 meters in height, while in another it may reach 20 meters. The trees include *Trichilia minutiflora* (Lundell 3949, 3951), *T. havanensis* (3950), *Sideroxylon meyeri* (3947), *Sapium jamaicense* (2192), *Sebastiania longicuspis* (4304), *Misanteca* sp. (2216), *Parmentiera edulis* (2079), *Myriocarpa obovata* (2194), *Lucuma durlandii* (2154), *Louteridium donnell-smithii* (2081), *Lætia thamnina* (3952), *Deherainia smaragdina* (2199), *Annona* sp., *Sabal* sp., *Pimenta officinalis*, *Protium copal*, *Ocotea lundellii*, and species of *Zanthoxylum*, *Pithecolobium*, *Talisia*, *Cordia*, and *Croton*. The floristic composition of the middle and lowest tree tiers is most varied. It is much easier to obtain specimens from the smaller trees, and for that reason the lower tier is more amply represented by collections. It is to be understood that younger trees of the upper tier species are prominent throughout. Often there are more representatives of such trees as *Lucuma campechiana*, *Bursera simaruba*, and *Spondias mombin* in the lower than in the upper reaches.

Lianas with their foliage in the tree tops abound, but the difficulty in making collections has delayed their identification. The Bignoniaceæ appear to be widely represented. I collected only one species, *Clytostoma mayanum* (Lundell 4008).

The underwood varies considerably in height. As in the *ramonal* the species of *Piper* are frequently characteristic. Among them are *Piper nitidulifolium* (Lundell 1486), *P. psilorhache* (1484, 1485), *P. stevensonii* (?) (1462), *P. yaxhanum* (3826), *P. quadratilimum* (1488), and *P. yucatanense* (1487). Other shrubs are *Ruellia stemonacanthoides* (4094), *Justicia breviflora* (4096), *Odontonema callistachyum* (1646), *Alibertia edulis* (3175), *Psychotria flava* (1643), *P. ærstediana* (1577), *P. fruticetorum* (4252), *Aphelandra deppeana* (1447), *Acalypha* sp. (4095), and *Belopetone aurea* (2189). Palms, chiefly the *escoba*, *Cryosophila argentea*, and species of *Chamædorea*, are often present in considerable numbers.

The herbaceous growth is varied. On the Yaxha-Remate road grew a large patch of *Pharus parvifolius* (Lundell 2014), a grass. On the damp shaded forest floor near El Paso, the fern, *Dryopteris subtetragona* (1513, 1593), was common. The many small communities of heliophobous herbs merit detailed investigation.

The giant root-climbing aroids, *Monstera* spp., *Philodendron smithii* (Lundell 1572), and non-climbing *Anthurium tetragonum* var. *yucatanense* (1573) cover the trunks of many trees. The small epiphytic *Peperomia polochicana* (1626, 2191), *P. lundellii* (1625), *P. chucanebana* (1578), and *P. glutinosa* (1575) grow on branches in the thin mantle of humus and moss. On a tree trunk along the Fallabon-Yaxha road I found the scandent, fleshy *Begonia glabra* (2016).

On the tree trunks and in the crowns there are numerous epiphytic orchids, ferns, and bromelioids, a wealth of very interesting species.

In this discussion the writer has taken into account only the species which he collected or noted personally. Bartlett (1935b, pp. 16 to 20) lists a considerable number of plants for various upland associations. The annotated catalogue (p. 49) includes many additional species collected in climax forest.

The 64 species collected by the writer in the climax forest of Northern Petén are given in the following systematic list.

## TREES:

Ulmaceæ	<i>Celtis trinervia</i> Lam. 4306.
Moraceæ	<i>Ficus arstediana</i> Miq. 2200.
	<i>Ficus radula</i> Willd. Copo. 3181.
Urticaceæ	<i>Myriocarpa obovata</i> Donn. Sm. 2194.
Annonaceæ	<i>Annona</i> sp. 2213, 2215.
Lauraceæ	<i>Ocotea lundellii</i> Standl. 4359.
	<i>Misanteca</i> sp. 2216.
Meliaceæ	<i>Trichilia havanensis</i> Jacq. 3950.
	<i>Trichilia minutiflora</i> Standl. 3949, 3951.
Euphorbiaceæ	<i>Sebastiania longicuspis</i> Standl. Chechem blanco. 4304.
	<i>Sapium jamaicense</i> Sw. 2192.
Flacourtiaceæ	<i>Lætia thamnina</i> L. 3952.
Theophrastaceæ	<i>Deherainia smaragdina</i> (Planch.) Dcne. 2199.
Sapotaceæ	<i>Bumelia mayana</i> Standl. 2201.
	<i>Lucuma campechiana</i> HBK. 3948.
	<i>Lucuma durlandii</i> Standl. 2154.
	<i>Sideroxylon amygdalinum</i> Standl. 3935.
	<i>Sideroxylon meyeri</i> Standl. Laurelillo. 3947.
Verbenaceæ	<i>Vitex gaumeri</i> Greenm. Yaxnic. 1509.
Bignoniaceæ	<i>Parmentiera edulis</i> DC. 2079.
Acanthaceæ	<i>Louteridium donnell-smithii</i> Wats. 2081.

## SHRUBS AND TREELETS:

Palmae	<i>Chamædorea</i> sp.
Piperaceæ	<i>Piper sempervirens</i> (Trel.) Lundell. 3828.
	<i>Piper colaphitolerans</i> Trel. 3827.
	<i>Piper nitidulifolium</i> Trel. 1486.
	<i>Piper psilorhache</i> C. DC. 1484, 1485.
	<i>Piper quadratilimbium</i> Trel. 1488.
	<i>Piper stevensonii</i> Trel. (?). 1462.
	<i>Piper yaxhanum</i> Trel. 3826.
	<i>Piper yucatanense</i> C. DC. 1457, 1487.
Annonaceæ	<i>Guatteria leiophylla</i> (Donn. Sm.) Safford. 1157.
Capparidaceæ	<i>Forchammeria trifoliata</i> Radlk. Tres Marias. 1159.
Euphorbiaceæ	<i>Acalypha</i> sp. 4095.
Violaceæ	<i>Hybanthus yucatanensis</i> Millsp. 4307.
Acanthaceæ	<i>Aphelandra deppeana</i> Schl. & Cham. 1447.
	<i>Justicia breviflora</i> (Nees) Rusby. 4096.
	<i>Odontonema callistachyum</i> (Schl. & Cham.) Kuntze. 1646.
	<i>Ruellia stemonacanthoides</i> (Erst.) Hemsl. 4094.
Rubiaceæ	<i>Alibertia edulis</i> (L. Rich.) A. Rich. Guayabillo. 3175.
	<i>Psychotria flava</i> Erst. 1643.
	<i>Psychotria fruticetorum</i> Standl. 4252.
	<i>Psychotria arstediana</i> Standl. 1577.

## LIANAS AND WOODY SCRAMBLERS:

Gramineæ	<i>Arthrostylidium pittieri</i> Hack. Carrizo. 1140.
Bignoniaceæ	<i>Clytostoma mayanum</i> Standl. 4007, 4008.

## HERBACEOUS VINES:

- Commelinaceæ      *Neodonnellia grandiflora* (Donn. Sm.) Rose. 1595.

## HERBS:

- Polypodiaceæ      *Dryopteris subtetragona* (Link) Maxon. 1513, 1593.  
Gramineæ      *Pharus parvifolius* Nash. 2014.  
Commelinaceæ      *Dichorisandra hexandra* (Aubl.) Standl. (?). 1141.

## EPIPHYTES:

- Bromeliaceæ      *Æchmea bromeliæfolia* (Rudge) Bak. 4275.  
                     *Tillandsia balbisiana* Schult. f. 3960.  
Araceæ      *Anthurium æmulum* Schott. 1160.  
                     *Anthurium tetragonum* Hook. var. *yucatanense* Engl. 1573.  
                     *Philodendron smithii* Engl. 1572.  
Orchidaceæ      *Ionopsis utricularioides* (Sw.) Lindl. 3898.  
                     *Notylia trisepala* Lindl. & Paxt. 3899.  
                     *Pleurothallis brighami* Wats. (?). 1158.  
                     *Pleurothallis stenostachya* Rehb. f. 1156.  
Piperaceæ      *Peperomia chucanebana* Trel. 1578.  
                     *Peperomia glutinosa* Millsp. 1575.  
                     *Peperomia lundellii* Trel. 1625.  
                     *Peperomia polochicana* Trel. 1626, 2191.  
Begoniaceæ      *Begonia glabra* Aubl. 2016.

## PARASITES:

- Loranthaceæ      *Phoradendron cheiroparpum* Trel. 3832.

## SECONDARY SUCCESSIONAL STAGES

The population of Northern Petén is small, yet the inhabited clearings, road openings, *milpas*, *zacatales*, garden plots, and abandoned areas are of considerable extent. The vegetation of the clearings consists largely of cultivated and weedy plants. Some of the abandoned areas which were long subject to disturbance have retrogressed to savannas, others are *acahuales* (secondary forests) of various ages characterized by complex growth which is manifested in definite successional stages. Studies were confined mainly to inhabited clearings, cultivated areas, savannas, and *acahuales* in the uplands.

In sparsely settled country, man's influence on the aquatic associations is slight. In Northern Petén the rise of the water-level in the lakes has resulted in a flux of the vegetation of the littoral zone and strand. Of clearings in wooded swamps, I know of only one, a small area opened up for an air field on the south bank of the San Pedro de Martir River across from El Paso. No notes were made on its secondary vegetation.

*Inhabited clearings*—Although the inhabited clearings are all located on banks of *aguadas*, lakes, and rivers, they occupy uplands which in most instances formerly supported high climax forest. A few forest relics remain as shade, food, and fruit trees in some clearings, but in others none has survived. Among the cultivated plants are fruit, forage, and food trees, shrubs such as cacao and coffee, perennial herbs such as the banana and plantain, and other herbs important for medicine and food (Lundell, 1933c). Some grow scattered through the clearings,



others are found only in the individual enclosures (Plate 6). Many species in the inhabited clearings are common pantropical weeds (Plate 11, fig. 1).

Collections in clearings, given in the systematic list which follows, are from Yaxha, Remate, Tayasal, San Benito, Flores, El Paso, the air port across from Flores, and various *ranchos*, villages, chicle stations, and roads scattered through Northern Petén. A few species, such as the coconut, *ramon*, breadfruit, *zapote*, *anonas*, etc., which were noted but not collected, are included in the list. The collection numbers are those of the writer, unless otherwise indicated.

## TREES:

Palmæ	<i>Cocos nucifera</i> L. Coco.
	<i>Sabal mexicana</i> Mart. Huano de sombrero.
Moraceæ	<i>Artocarpus communis</i> Forst.
	<i>Brosimum alicastrum</i> Sw. Ramon.
Annonaceæ	<i>Annona cherimola</i> Mill. Chirimoya.
	<i>Annona muricata</i> L. Guanabana.
	<i>Annona reticulata</i> L.
	<i>Annona squamosa</i> L. Zaramuya.
Lauraceæ	<i>Persea americana</i> Mill. Aguacate.
Anacardiaceæ	<i>Anacardium occidentale</i> L. Marañon. 1504.
Myrtaceæ	<i>Psidium guajava</i> L. Guayabo.
Sapotaceæ	<i>Achras zapota</i> L. Zapote.
	<i>Chrysophyllum cainito</i> L. Caimito.

## SHRUBS AND TREELETS:

Piperaceæ	<i>Piper andresense</i> Trel. 3203.
	<i>Piper andresense</i> Trel. var. <i>subcalvescens</i> Trel. 2011.
	<i>Piper rematense</i> Trel. 2087.
Leguminosæ	<i>Pithecolobium pachypus</i> Pittier. Tucuy. 2090, 3242.
Euphorbiaceæ	<i>Jatropha hastata</i> Jacq. 1597.
Malvaceæ	<i>Hibiscus mutabilis</i> L. 1559.
Sterculiaceæ	<i>Theobroma cacao</i> L. Cacao.
Lythraceæ	<i>Lawsonia inermis</i> L. 3178.
Oleaceæ	<i>Jasminum sambac</i> (L.) Ait. Jazmina. 1560.
Apocynaceæ	<i>Thevetia peruviana</i> (Pers.) K. Sch. Acitz. 3133.
Labiataæ	<i>Hyptis verticillata</i> Jacq. 1454.
Solanaceæ	<i>Solanum bicolor</i> Willd. 2012.
	<i>Solanum diversifolium</i> Schlecht. 2074.
Rubiaceæ	<i>Coffea arabica</i> L. Cafe.

## HERBACEOUS VINES:

Convolvulaceæ	<i>Quamoclit coccinea</i> (L.) Mœnch. 3988.
Solanaceæ	<i>Lycianthes lenta</i> (Cav.) Bitter. 2151.
Acanthaceæ	<i>Thunbergia alata</i> Bojer. 1598.
Cucurbitaceæ	<i>Elaterium ciliatum</i> Cogn. 1539.
	<i>Lagenaria siceraria</i> (Molina) Standl. Bux, Lec. 3936, 3939, 4266, 4284.
	<i>Melothria guadalupensis</i> (Spreng.) Cogn. 1588.

## HERBS:

Gramineæ	<i>Cenchrus brownii</i> Roem. & Schult. 1541.
	<i>Digitaria horizontalis</i> Willd. 1468.
	<i>Digitaria sanguinalis</i> (L.) Scop. 1534.
	<i>Eleusine indica</i> (L.) Gært. 1602, 3856.
	<i>Eragrostis ciliaris</i> (L.) R. Br. 3855.
	<i>Oplismenus hirtellus</i> (L.) Beauv. 1594.
	<i>Panicum fasciculatum</i> Sw. 3859.
	<i>Panicum reptans</i> L. 1535.
	<i>Panicum trichanthum</i> Nees. 1538.

	<i>Paspalum cæspitosum</i> Fl. 3858.
	<i>Paspalum langei</i> (Fourn.) Nash. 1552.
Cyperaceæ	<i>Cyperus oxycarioides</i> Britton. 1548, 2091.
	<i>Cyperus tenerrimus</i> Presl. 1604, 2086.
	<i>Fimbristylis miliacea</i> (L.) Vahl. 1605.
	<i>Kyllinga pumila</i> Michx. 1603.
Musaceæ	<i>Musa paradisiaca</i> L. Platano.
	<i>Musa sapientum</i> L. Guineo.
Moraceæ	<i>Dorstenia contrajerva</i> L. 4257.
Amaranthaceæ	<i>Alternanthera polygonoides</i> (L.) R. Br. 3314.
	<i>Amaranthus spinosus</i> L. Ixtez. 3179.
	<i>Iresine celosia</i> L. 1546.
Chenopodiaceæ	<i>Chenopodium ambrosioides</i> L. Apazote. 3225.
Nyctaginaceæ	<i>Bærhoavia erecta</i> L. 1582, 4260.
	<i>Mirabilis violacea</i> (L.) Heimerl. 4206.
Phytolaccaceæ	<i>Phytolacca icosandra</i> L. 2089, 3241.
	<i>Rivina humilis</i> L. 1467, 4251.
Capparidaceæ	<i>Cleome serrata</i> Jacq. 1576, 4204.
Leguminosæ	<i>Desmanthus virgatus</i> (L.) Willd. 1503, 3223.
	<i>Desmodium frutescens</i> (Jacq.) Schindl. 1561, 4392.
Zygophyllaceæ	<i>Kallstræmia maxima</i> (L.) Torr. & Gray. 4205.
Euphorbiaceæ	<i>Acalypha setosa</i> A. Rich. Corrimiento. 1511.
	<i>Codiaeum variegatum</i> (L.) Blume. 4258.
	<i>Euphorbia armourii</i> Millsp. 1482.
	<i>Euphorbia brasiliensis</i> Lam. 4120.
	<i>Euphorbia heterophylla</i> L. Aguilar 24.
	<i>Euphorbia hirta</i> L. 4125.
	<i>Euphorbia hypericifolia</i> L. 1514.
	<i>Euphorbia lasiocarpa</i> Klotzsch. 4124.
	<i>Euphorbia thymifolia</i> L. 4259.
	<i>Phyllanthus ferax</i> Standl. 4126.
Malvaceæ	<i>Malachra capitata</i> L. 1536.
	<i>Malvastrum coromandelianum</i> (L.) Garcke. 1589.
Violaceæ	<i>Hybanthus angustifolius</i> (HBK.) Standl. 4225.
	<i>Hybanthus longipes</i> (Dowell) Standl. 4254.
Loganiaceæ	<i>Spigelia humboldtiana</i> Cham. & Schl. 4263.
Hydrophyllaceæ	<i>Nama jamaicense</i> L. Aguilar 162.
Boraginaceæ	<i>Heliotropium angiospermum</i> Murray. Yerba Martin. 2211.
Verbenaceæ	<i>Bouchea prismatica</i> (L.) Kuntze. Aguilar 166.
	<i>Lippia dulcis</i> Trev. 3302.
	<i>Lippia reptans</i> HBK. 1544.
	<i>Lippia stæchadifolia</i> (L.) HBK. 1471.
Labiataæ	<i>Hyptis capitata</i> Jacq. 1453.
	<i>Salvia lavanduloides</i> HBK. (?). 1596.
	<i>Salvia obscura</i> Benth. 1545.
	<i>Teucrium inflatum</i> Sw. 2209.
Solanaceæ	<i>Nicotiana tabacum</i> L. Aguilar 59.
	<i>Physalis lagasce</i> Roem. & Schult. 1563, 1590.
	<i>Solanum wendlandii</i> Hook. f. Ixcan. Aguilar 161.
Scrophulariaceæ	<i>Capraria biflora</i> L. 2013, 2212.
Acanthaceæ	<i>Justicia comata</i> (L.) Lam. 1609.
	<i>Ruellia nudiflora</i> var. <i>yucatanæ</i> Leonard. 1516.
Rubiaceæ	<i>Borreria verticillata</i> (L.) Mey. Aguilar 27.
Lobeliaceæ	<i>Isotoma longiflora</i> (L.) Presl. 1481.
Compositæ	<i>Bidens pilosa</i> L. 1510, 4017.
	<i>Eclipta alba</i> (L.) Hassk. 1523, 1547.
	<i>Eleutheranthera ruderalis</i> (Sw.) Sch. Bip. Thamacas. 3180.
	<i>Epaltes mexicana</i> Less. 1508.
	<i>Melanthera nivea</i> (L.) Small. 4015.
EPHIPHYTES:	
Bromeliaceæ	<i>Tillandsia usneoides</i> L. 2210.

*Cultivated areas*—*Milpas*, sugarcane plantations, orchard and vegetable plots, and *zacatales* comprise the principal agricultural clearings. The *milpa* system of agriculture as described on page 11 is employed almost exclusively to raise the staple crops, maize and beans.

On the shores of Lake Petén exist several sugarcane plantations which supply brown sugar to the local population. The cane thrives on the alluvial soils (Plate 13, fig. 2). Small orchards in which bananas, plantains, *aguacates*, mangoes, etc., are grown, and vegetable plots are likewise to be found on the lake banks, the water facilities for transportation accounting for their location.

Much of the chicle and incoming merchandise is transported by mule-trains. To feed the mules, *milpas*, after producing maize and beans for one or two years, are sodded with grass (*zacate*) and become *zacatales*. Around chicle stations, including El Paso, Laguna Perdida, El Zotz, Isabelita, and many others in the interior which have been abandoned recently, and in the vicinity of each village, extensive *zacatales* are to be found. These planted grasslands in Northern Petén are much the same as those previously described from Campeche (Lundell, 1934b, p. 293).

At San Felipe, Campeche, a place abandoned for more than a decade, an extensive *zacatal* still existed when I visited the place in March 1932. Occasional travelers have burned the area, and consequently the grass has maintained its position. It will be interesting to note how long this *zacatal* will survive against the encroaching forest.

The spontaneous growth in the cultivated areas is chiefly weedy with the Gramineæ, Convolvulaceæ, Compositæ, Solanaceæ, Cucurbitaceæ, and Passifloraceæ abundantly represented both in number of species and individuals.

*Savannas*—In Northern Petén near Lake Petén exist several well-drained upland areas which are characterized by savanna vegetation (Plates 20 and 21). The *rendzina* soils without exception are reddish calcareous clays of no greater depth than in the climax forest. Through continued occupation as inhabited sites, or by *milpa* rotation and subsequent fire destruction, the retrogression of the vegetation to the present state has resulted. I am convinced that the savanna vegetation in the Northern Petén savannas is maintained in the present condition by fire, and that forest would completely reclaim them if fires were controlled. Even in spite of fires, it is evident that forest growth of fire-resistant species is encroaching on the areas. At Kantetul scrub growth has almost completely overrun the savanna (Plate 21).

I investigated the savanna growth on the Tayasal peninsula, and north of Lake Petén in Sabana Zis, Sabana Tzimintun, and at Kantetul. At the first three localities fire-resistant scrubby trees, scattered through the open grasslands (Plate 20), include the *zackuche*, *Hippocratea subintegra* (Lundell 3193), the *zitzya*, *Dipholis salicifolia* (3197), the *chique*, *Ternstræmia tepezapote* (3204), the *saha*, *Curatella americana*, and the *nanze*, *Byrsonima crassifolia*. The last two are commonest.

I visited the areas in May after they had been swept by fires, so that little remained of the herbaceous growth (Plate 20). The species that had survived and were in flower included the perennials *Brickellia oliganthes* (Lundell 4013), *Orthopappus angustifolius* (4014), *Anemia adiantifolia* (3891, 4706), *Stenorrhynchus orchoides* (3134, 3897), *Asclepias longicornu* (4060), and two grasses, *Bouteloua triæna* (3860), and *Pentarrhaphis scabra* (3196). Most of the herbaceous species in the savannas have fleshy roots, corms, or woody underground stems which enable them to survive fire and drouth.

Around Sabana Zis and Sabana Tzimintun the marginal forest is made up of an outer belt of scrubby species followed inland by a belt of taller trees which intergrade into the surrounding forest. In the outer scrubby belt I collected the *limonaria cimarron*, *Polygala jamaicensis* (Lundell 3187), the *jaboncillo*, *Diospyros yucatanensis* (3194), the *bakke*, *Rondeletia belizensis* (3188), and *zarza*, *Smilax lundellii* (3190), a vine. Among the trees in the marginal forest are the *yaaxhochoc*, *Ocotea lundellii* (3195), the *cataox* or *lloro sangre*, *Swartzia lundellii* (3189), the *hubuche*, *Clusia flava* (3238), and *Oreopanax guatemalense* (3135). On one of the trees I discovered the *kimiche* or *mata palo*, *Phoradendron aurantiacum* (3191), a crown parasite. Most of the species are calciphiles.

Sabana Zis (Plate 20, fig. 1) and Sabana Tzimintun (Plate 20, fig. 2) adjoin each other (Plate 10). Both are quite small, scarcely exceeding 100 meters in width and together not more than two kilometers long.

In Sabana Tzimintun the stone foundations, shown in Plate 20, figure 2, are said to be remains of the structure in which a stone image of the horse of Cortes was carved. *Tzimin* is horse and *tun* is stone in Maya, hence the name Tzimintun for the place. The spot lies on top of the hills overlooking Lake Petén (Plate 10). It is said that the stone image was so heavy that the boat in which it was being transported to Tayasal capsized in a storm in the middle of the lake. According to a Maya story in San Andres, it was possible formerly, before the rise of the water-level, to see the stone horse when the lake was calm and clear.

The savanna at Kantetul (Plate 1) covers the site of an old Maya city. The retrogression of the vegetation there may have been the result of long-continued occupation followed by fire destruction since abandonment. Until recently the site has been used as a station and *potrero* by chicle operators. Kantetul lies in a valley near an *arroyo* so that the red clay soils are somewhat deeper than on the hills, and may have favored grassy growth.

Since abandonment by chicle contractors, the place has been largely free from disturbance. Although somewhat extensive open areas are said to have been present a few years ago, when I visited the ruins in May 1933 the site was entirely overgrown by scrubby species (Plate 21). Forest probably will reclaim the area rapidly. The species overrunning the savanna are present in other Northern Petén savannas as scattered trees and marginal growth. That these pioneer invading species will be replaced eventually by mesophytic species is a foregone conclusion.

To trace the succession in such an area from the savanna stage through all phases to the climax forest will be most important. Succession in the uplands apparently varies in its initial phases according to the state of the area. In other words, different species appear to characterize successional stages in savannas, abandoned inhabited clearings, abandoned *milpas* of recently cleared climax forest, abandoned *milpas* of cleared *acahual*, etc. By noting the state to which an area has retrogressed floristically and edaphically, it may be possible to predict what successional stages will ensue if the area is left undisturbed. Other botanists visiting Kantetul are urged to collect through the ruins and record dominant species so that at least some of the stages of the sere in such a savanna area will be known.

The prominent trees in the savanna at Kantetul were the *abalche*, *Ximenia americana* (Lundell 3183), the *tah*, *Lippia myriocephala* (3171), the *zupte*, *Lysiloma desmostachys* (3172), the *saha*, *Curatella americana*, the *nanze*, *Byrsonima crassifolia*, and *Acacia angustissima*. Two large shrubs, *Piper kantetulense* (3173) and *Piper multinervium* (3168), were common.

Of the herbaceous growth I collected two tall grasses, the *ac*, *Imperata contracta* (Lundell 3167), and the *chachihuhe*, *Andropogon condensatus* (3169), a leguminous vine called *ixbeho*, *Rhynchosia longeracemosa* (3166), and the composite, *Calea urticifolia* (3174).

There are other small savannas in the uplands around Lake Petén. The existence of these savannas on the *rendzina* soils of the region is very interesting, for their presence indicates that long-continued human occupation of the land, coupled probably with fire destruction, results in savanna conditions even in humid limy areas which naturally support forest vegetation.

In the following systematic list are given the plants found in the grasslands and around the margins of the Northern Petén savannas. A detailed survey would greatly increase the number of species. The collection numbers are those of the writer, unless otherwise indicated.

## TREES:

Olacaceæ	<i>Ximenia americana</i> L. <i>Abalche</i> . 3183.
Lauraceæ	<i>Ocotea lundellii</i> Standl. <i>Yaaxhochoc</i> , <i>Laurel</i> . 3195.
Leguminosæ	<i>Acacia angustissima</i> (Mill.) Kuntze.
	<i>Lysiloma desmostachys</i> Benth. <i>Zupte</i> . 3172.
	<i>Swartzia lundellii</i> Standl. <i>Cataox</i> , <i>Lloro sangre</i> . 3189.
Malpighiaceæ	<i>Byrsonima crassifolia</i> (L.) HBK. <i>Nanze</i> .
Hippocrateaceæ	<i>Hippocratea subintegra</i> Blake. <i>Zackuche</i> . 3193.
Dilleniaceæ	<i>Curatella americana</i> L. <i>Saha</i> .
Ternstroemiaceæ	<i>Ternstroemia tepezapote</i> Schl. & Cham. <i>Chique</i> . 3204.
Clusiaceæ	<i>Clusia flava</i> Jacq. <i>Hubuche</i> . 3238.
Araliaceæ	<i>Oreopanax guatemalense</i> (Lem.) Dcne. & Planch. 3135.
Sapotaceæ	<i>Dipholis salicifolia</i> (L.) A. DC. <i>Zitzya</i> . 3197.
Verbenaceæ	<i>Lippia myriocephala</i> Schl. & Cham. <i>Tah</i> . 3171.

## SHRUBS:

Piperaceæ	<i>Piper kantetulense</i> Trel. 3173.
	<i>Piper multinervium</i> Mart. & Gal. 3168.

Polygalaceæ	<i>Polygala jamaicensis</i> Chodat. <i>Limonaria cimarron</i> . 3187.
Ebenaceæ	<i>Diospyros yucatanensis</i> Lundell. <i>Jaboncillo</i> . 3194.
Rubiaceæ	<i>Rondeletia belizensis</i> Standl. <i>Bakke</i> . 3188.
LIANAS:	
Smilacaceæ	<i>Smilax lundellii</i> Killip & Morton. 3190.
HERBACEOUS VINES:	
Leguminosæ	<i>Rhynchosia longeracemosa</i> Mart. & Gal. <i>Ixbeho</i> . 3166.
HERBS:	
Schizæaceæ	<i>Anemia adiantifolia</i> (L.) Sw. 3891, 4706.
Gramineæ	<i>Andropogon condensatus</i> HBK. <i>Chachihuhe</i> . 3169.
	<i>Bouteloua triæna</i> (Spreng.) Scribn. 3860.
	<i>Imperata contracta</i> (HBK.) Hitchc. <i>Ac</i> . 3167.
	<i>Pentarrhaphis scabra</i> HBK. 3196.
Orchidaceæ	<i>Stenorrhynchus orchioides</i> (Sw.) L. C. Rich. 3134, 3897.
Asclepiadaceæ	<i>Asclepias longicornu</i> Benth. 4060.
Compositæ	<i>Brickellia oliganthes</i> (Less.) Gray. 4013.
	<i>Calea urticifolia</i> (Mill.) DC.
	<i>Orthopappus angustifolius</i> (Sw.) Gleason. 4014.
PARASITES:	
Loranthaceæ	<i>Phoradendron aurantiacum</i> Trel. <i>Kimiche</i> , <i>Mata palo</i> . 3191.

*Acahual*es—All secondary upland vegetation of stages leading to the climax forest is called *acahual*. The *acahual* vegetation ranges from the spontaneous growth of recently abandoned inhabited clearings, *milpas*, etc., to initial secondary growth of forest subjected to retrogression by fire destruction, through all phases to the climax associations. As previously noted, the stages of the successions in *acahual*es vary, at least in initial phases, according to the state of the retrogressed area floristically and edaphically. The stages of the successional vegetation in each type of area are characterized by certain dominant species by which the successional associations may be recognized.

In general the *acahual*es are similar to those previously described (Lundell, 1934b, pp. 272 and 294).

In the preliminary surveys in Northern Petén, no time was available for critical studies of the *acahual* areas. The collections from El Paso were made in abandoned inhabited clearings and *milpa* areas which had been rotated in cultivation over a period of years. Other scattered collections are from *acahual*es of various ages.

The systematic list which follows includes the majority of plants collected in *acahual*es. Many of the species are typical of definite *acahual* stages not possible to differentiate because it was not possible to make sufficiently thorough collections. Bartlett (1935b) discusses several of the important secondary successional associations and lists plants characterizing them. The collection numbers are those of the writer, unless otherwise indicated.

## TREES:

Moraceæ	<i>Cecropia</i> sp. <i>Guarumo</i> . 3295, 3296.
Lauraceæ	<i>Nectandra sanguinea</i> Rottb. (?). 1528.
Leguminosæ	<i>Cassia spectabilis</i> DC. 2075.
	<i>Pithecolobium macrandrium</i> Donn. Sm. <i>Motilla</i> . <i>Aguilar</i> 3.



- Meliaceæ *Trichilia montana* HBK. 1459.  
 Simarubaceæ *Alvaradoa amorphoides* Liebm. 4391.  
 Euphorbiaceæ *Adelia barbinervis* Schl. & Cham. 1478.  
*Croton macrodontus* Muell. Arg. (?). 4128.  
*Croton niveus* Jacq. 2153, 4127.  
*Croton reflexifolius* HBK. 4122.  
*Gymnanthes lucida* Sw. 4129.  
*Sebastiania adenophora* Pax. & Hoffm. 1607.  
 Anacardiaceæ *Metopium brownei* (Jacq.) Urban. Chechem. 2080.  
 Sapindaceæ *Talisia floresii* Standl. 1480.  
 Tiliaceæ *Muntingia calabura* L. Capolin blanco. 1452, 3142.  
 Sterculiaceæ *Guazuma ulmifolia* Lam. 1515.  
 Myrtaceæ *Eugenia capuli* (Schl. & Cham.) Berg. 1530.  
 Sapotaceæ *Lucuma campechiana* HBK. Kanizte. 3192.  
 Apocynaceæ *Tabernaemontana chrysocarpa* Blake. 1456.  
 Boraginaceæ *Cordia glabra* L. 1659.  
 Solanaceæ *Cestrum panamense* Standl. 1650.
- SHRUBS AND TREELETS:
- Piperaceæ *Piper auritum* HBK. 1491.  
*Piper nitidulilaminum* Trel. 2077.  
*Piper simulhabitans* Trel. 2073.  
 Leguminosæ *Acacia collinsii* Safford (?). Subin.  
*Acacia cookii* Safford (?). Subin.  
*Acacia spadicigera* Schl. & Cham. 1608.  
*Calliandra* sp. Chultejillo. Aguilar 26.  
*Cassia petensis* (Britt. & Rose) Standl. 4393.  
*Indigofera suffruticosa* Mill. 1542.  
*Mimosa pigra* L. 3114.  
*Pithecolobium lanceolatum* (Humb. & Bonpl.) Klotzsch. 1610; Aguilar 21.  
*Pithecolobium pachypus* Pittier. 3182, 3243.  
 Malpighiaceæ *Malpighia glabra* L. 1585.  
 Euphorbiaceæ *Acalypha flagellata* Millsp. 1493.  
*Acalypha unibracteata* Muell. Arg. 4121.  
*Jatropha tubulosa* Muell. Arg. 3131.  
*Pedilanthus tithymaloides* Poit. 3144.  
*Phyllanthus conami* Sw. Aguilar 22.  
*Phyllanthus micrandrus* Muell. Arg. 1458.  
*Phyllanthus nobilis* (L. f.) Muell. Arg. 3136, 4338.  
*Triumfetta semitriloba* Jacq. 1551.  
 Tiliaceæ *Abutilon lignosum* (Cav.) Don. 1540.  
 Malvaceæ *Helicteres guazumæfolia* HBK. 1657.  
 Sterculiaceæ *Prockia crucis* L. Mozote. 4340.  
 Flacourtiaceæ *Ardisia paschalis* Donn. Sm. Chilil. 3177, 4337.  
 Myrsinaceæ *Parathesis obovata* Standl. 3112.  
*Thevetia ahouai* A. DC. Cojon de perro. 3239.  
 Apocynaceæ *Cordia ferruginea* (Lam.) Roem. & Schult. 1461, 1579.  
 Boraginaceæ *Tournefortia hirsutissima* L. 1463.  
 Verbenaceæ *Ægiphila monstrosa* Moldenke. 1492.  
*Callicarpa acuminata* HBK. 2088.  
 Solanaceæ *Cestrum nocturnum* L. Dama de noche. 2017, 4253.  
*Lycianthes hypoleuca* Standl. 3986.  
*Lycianthes variifolia* Standl. 4006.  
*Solanum diversifolium* Schlecht. 1448.  
*Solanum erythrotrichum* Fernald. 4004.  
*Solanum hirtum* Vahl. 1584.  
*Solanum lanceifolium* Jacq. 1460, 1465, 2203.  
*Solanum nudum* HBK. 3224.  
 Acanthaceæ *Jacobinia spicigera* (Schl.) L. H. Bailey. 1549.  
 Rubiaceæ *Hamelia rovirosæ* Wernham. 1600.  
*Psychotria flava* CErst. 4202.

- Compositæ  
*Psychotria limonensis* Krause. 4226.  
*Psychotria pubescens* Sw. 3176.  
*Baccharis trinervis* (Lam.) Pers. 1455, 3305.  
*Eupatorium albicaule* Sch. Bip. 4011, 4016.  
*Eupatorium odoratum* L. 1570.  
*Pluchea odorata* (L.) Cass. 1581, 2030.  
*Trixis radialis* (L.) Kuntze. 1586.  
*Vernonia tortuosa* (L.) Blake. 1651.

## LIANAS AND WOODY SCRAMBLERS:

- Palmæ  
*Desmoncus lundellii* Bartlett. Bayal. 1555.  
Capparidaceæ  
*Capparis baducca* L. 3132.  
Leguminosæ  
*Mimosa pseudopaniculata* Britton. 1450.  
Malpighiaceæ  
*Mascagnia polycarpa* T. S. Brandeg. 1520.  
Sapindaceæ  
*Cardiospermum grandiflorum* Sw. 1583.  
*Serjania cardiospermoides* Schl. & Cham. (?). 2019.  
*Serjania mexicana* (L.) Willd. 1446.  
*Serjania pterantha* Standl. 1531.  
*Urvillea ulmacea* HBK. 1550, 2031.  
Vitaceæ  
*Cissus sicyoides* L. 1494.  
*Vitis tiliæfolia* Humb. & Bonpl. 1642.  
Sterculiaceæ  
*Byttneria aculeata* Jacq. 1526.  
*Byttneria catalpifolia* Jacq. 1495.  
Combretaceæ  
*Combretum farinosum* HBK. 1529.  
Labiata  
*Hyptis* sp. 4421.  
Scrophulariaceæ  
*Russelia campechiana* Standl. 1644.  
Bignoniaceæ  
*Adenocalymna* sp. 1554.  
*Cydista diversifolia* (HBK.) Miers. 1489.  
*Chiococca alba* (L.) Hitchc. 4203.  
*Morinda yucatanensis* Greenm. 3143.  
Rubiaceæ  
*Eupatorium morifolium* Mill. 1645.  
Compositæ

## SUFFRUTESCENT AND HERBACEOUS VINES AND SCRAMBLERS:

- Schizæaceæ  
*Lygodium polymorphum* (Cav.) HBK. 2032.  
Gramineæ  
*Lasiacis divaricata* (L.) Hitchc. 1587.  
*Lasiacis ruscifolia* (HBK.) Hitchc. 3861, 3862.  
Menispermaceæ  
*Cissampelos tomentosa* DC. 1525.  
Leguminosæ  
*Canavalia villosa* Benth. 1451.  
*Centrosema virginianum* (L.) Benth. 2076.  
*Rhynchosia minima* (L.) DC. 1569.  
Passifloraceæ  
*Passiflora biflora* Lam. 1490; Aguilar 165.  
*Passiflora suberosa* L. 3844.  
Apocynaceæ  
*Mesechites trifida* (Jacq.) Muell. Arg. 1567.  
Convolvulaceæ  
*Ipomœa cathartica* Poir. 1601.  
*Ipomœa sagittata* Lam. (?). 1532.  
*Ipomœa tiliacea* (Willd.) Choisy. 1557.  
*Ipomœa triloba* L. 3113.  
*Merremia umbellata* (L.) Hallier. 1556.  
Compositæ  
*Mikania micrantha* HBK. 1527.  
*Montanoa pauciflora* Klatt. 1537.  
*Senecio kermesinus* Hemsl. 4012.

## HERBS:

- Gramineæ  
*Lithachne pauciflora* (Sw.) Beauv. 3863.  
*Olyra yucatanica* Chase. 1574.  
Orchidaceæ  
*Stenorrhynchus orchiioides* (Sw.) L. C. Rich. 3896.  
Amaranthaceæ  
*Chamissoa altissima* (Jacq.) HBK. 1466.  
*Iresine nigra* Uline & Bray. 4308.  
Solanaceæ  
*Solanum nigrum* L. 1512.  
Compositæ  
*Eupatorium macrophyllum* L. 1483, 1649.  
*Goldmanella sarmentosa* Greenm. 1580.

*Melanthera deltoidea* Michx. Aguilar 409.

*Wedelia filipes* Hemsl. 1506.

*Zexmenia serrata* Llave. 3306.

PARASITES:

Loranthaceæ

*Phoradendron piperoides* (HBK.) Trel. 3186.

ANNOTATED LIST OF THE SPECIES COLLECTED OR OBSERVED IN NORTHERN PETÉN

The following annotated list contains approximately 785 species, the known flora of Northern Petén. All the species collected in the region by Cook and Martin,<sup>1</sup> Bartlett, Lundell, and Aguilar are included.

SCHIZÆACEÆ

*Anemia adiantifolia* (L.) Sw. Tayasal, Lundell 3891, 4706. Terrestrial; common in the grasslands covering Tayasal.

*Lygodium polymorphum* (Cav.) HBK. Masadamora. Yaxha-Remate road, Lundell 2032; without locality, Cook & Martin 55. Slender climbing vine; common in secondary upland forest.

POLYPODIACEÆ

*Acrostichum daneifolium* L. & F. Lake Zotz, Lundell 3310. Large coarse fern; common in the fern and sedge bog of Lake Zotz.

*Adiantum tenerum* Sw. Yocpich. Uaxactun, Bartlett 12189. Terrestrial; common on steep limestone declivities in climax forest.

*Adiantum tricholepis* Fée. Uaxactun, Bartlett 12268, 12756. Terrestrial; common on the ruins.

*Adiantum villosum* L. Uaxactun, Bartlett 12188. Terrestrial, 50 cm. high; common on steep limestone declivities in climax forest.

*Asplenium auritum* Sw. Uaxactun, Bartlett 12526; San Clemente-Dos Arroyos trail, Bartlett 12838. Terrestrial or epiphytic; common on hill caps in climax forest.

*Asplenium cristatum* Lam. Tikal, Bartlett 12615; without locality, Cook & Martin 69. Terrestrial; common on the ruins.

*Asplenium dentatum* L. Uaxactun, Bartlett 12261, 12475, 12787; without locality, Cook & Martin 151. Terrestrial; very common, covering limestone ledges and abundant on limestone in the ruins.

*Asplenium formosum* Willd. Muchcok. Uaxactun, Bartlett 12179; without locality, Cook & Martin 154. Terrestrial or epiphytic; common on decaying logs in climax forest, and also found on wet ground among the ruins.

*Asplenium pumilum* Sw. Uaxactun, Bartlett 12168; Tikal, Bartlett 12648. Terrestrial; common on limestone in climax forest, and among the ruins.

*Blechnum serrulatum* Rich. Lake Zotz, Lundell 3309. Coarse plant 1 meter high; common in the fern and sedge bog of Lake Zotz.

*Dryopteris equestris* (Kunze) C. Chr. Without locality, Cook & Martin 175.

*Dryopteris gongylodes* (Schkuhr.) Kuntze. Lake Zotz, Lundell 3318. Coarse plant 1 meter high; very abundant in the fern and sedge bog of Lake Zotz.

*Dryopteris melanosticta* (Kunze) Kuntze. Tikal, Bartlett 12587, 12644. Terrestrial; common among the ruins.

*Dryopteris patens* (Sw.) Kuntze. Uaxactun, Bartlett 12222, 12712. Terrestrial; common on the ruins and in forest along Arroyo Uaxactun.

*Dryopteris serrata* (Cav.) C. Chr. Lake Zotz, Lundell 3297. Large coarse plant; common in the fern and sedge bog of Lake Zotz.

*Dryopteris subtetragona* (Link) Maxon. El Paso, Lundell 1513, 1593; Uaxactun, Bartlett 12159. Terrestrial; common on wet soils in climax forest.

*Gymnopteris rufa* (L.) Underw. Tikal, Bartlett 12599. Terrestrial; common among the ruins.

<sup>1</sup> Excepting the pteridophytes and Passifloraceæ identified respectively by Dr. W. R. Maxon and Mr. E. P. Killip, all the Cook and Martin specimens were determined by Dr. P. C. Standley. The writer has not seen any of the collection.

*Nephrolepis biserrata* (Sw.) Schott. Lake Zotz, *Lundell 3320*; Remate-Yaxha road, *Lundell 3890*. Epiphytic; common on trunks of palms, and also present in the fern and sedge bog of Lake Zotz.

*Paltonium lanceolatum* (L.) Presl. Tikal, *Bartlett 12628*. Epiphytic; occasional on the ruins.

*Pityrogramma calomelæna* (L.) Link. Dos Arroyos, *Bartlett 12113*; Uaxactun, *Bartlett 12753*. Terrestrial; common in swamp forest and among the ruins.

*Polypodium crassifolium* L. Dos Arroyos-Yaloch road, *Bartlett 12845*. Epiphytic; occasional in climax forest.

*Polypodium lycopodioides* L. Uaxactun, *Bartlett 12294*. Epiphytic; occasional on the ruins.

*Polypodium palmeri* Maxon. Naachtun, *Lundell 1161*; San Andres, *Lundell 3222*. Small scandent epiphyte; common in open forest of hill caps and marginal areas.

*Polypodium phyllitidis* L. Uaxactun, *Bartlett 12148*. Terrestrial or epiphytic; occasional in the botanal on bank of Arroyo Uaxactun.

*Polypodium plumula* H. & B. Uaxactun, *Bartlett 12754*; Uaxactun-San Clemente trail, *Bartlett 12810*; San Clemente-Dos Arroyos trail, *Bartlett 12820*. Terrestrial; common among the ruins, and in climax forest.

*Pteridium caudatum* (L.) Maxon. Cis. Uaxactun, *Bartlett 12521*. Terrestrial; common in forest on steep limestone slopes.

*Pteris altissima* Poir. Tikal, *Bartlett 12589*; without locality, *Cook & Martin 143*. Terrestrial, 1 meter high; among the ruins.

*Pteris bicaurita* L. Uaxactun, *Bartlett 12718A*. Terrestrial; common on the ruins.

*Pteris grandifolia* L. Uaxactun, *Bartlett 12704*. Terrestrial; common on the ruins.

*Pteris quadriaurita* Retz. Uaxactun, *Bartlett 12718*. Terrestrial; common on the ruins.

*Tectaria heracleifolia* (Willd.) Underw. Uaxactun, *Bartlett 12187*. Terrestrial; in forest on a steep limestone slope.

*Vittaria filifolia* Fée. Tikal, *Bartlett 12600*. Epiphytic; on trees among the ruins.

*Vittaria lineata* (L.) J. E. Sm. Without locality, *Cook & Martin 176*.

#### HYMENOPHYLLACEÆ

*Trichomanes godmani* Hook. Uaxactun, *Bartlett 12249*. Epiphytic; common on botan palms in swamp forest (botanal).

*Trichomanes krausii* Hook. & Grev. Yaxha-Remate road, *Lundell 2054*; Uaxactun, *Bartlett 12525, 12531*. Epiphytic; abundant on trees in swamp forest (botanal), and occasional in climax forest.

*Trichomanes punctatum* Poir. Uaxactun, *Bartlett 12715*. In moist places around the ruins.

#### SALVINIACEÆ

*Salvinia auriculata* Aubl. San Pedro de Martir River, *Lundell 1565*. Floating aquatic; common in quiet water.

#### LYCOPODIACEÆ

*Lycopodium linifolium* L. Yaloch-El Cayo road, *Bartlett 12869*. Epiphytic; occasional on tree trunks.

#### SELAGINELLACEÆ

*Selaginella cuspidata* Link. Uaxactun, *Bartlett 12213*. Terrestrial; at edge of dry arroyo.

*Selaginella* sp. Uaxactun, *Bartlett 12542*. At edge of dry arroyo.

#### CYCADACEÆ

*Zamia furfuracea* L. f. Chacuhua. Uaxactun, *Bartlett 12191*; without locality, *Cook & Martin 147, 175*. Stemless plants 1 meter high or less; common in climax forest, occasional in swamp forest.

#### TYPHACEÆ

*Typha angustifolia* L. Lake Petén, *Lundell 3219*; Lake Zotz, *Lundell 3315*; Uaxactun, *Bartlett 12777*. Coarse perennial 2 meters high; common in lakes and aguadas.

## NAIADACEÆ

*Naias guadalupensis* (Spreng.) Morong. Lake Petén, *Lundell* 2027, 2029; Lake Yaxha, *Lundell* 2206, 2207. Small aquatic herb; very abundant in quiet shallow waters of Lake Yaxha and Lake Petén.

*Potamogeton lucens* L. Lake Petén, *Lundell* 2028, 3221; Lake Yaxha, *Lundell* 2204, 2205. Aquatic herb; common in lakes.

## ALISMACEÆ

*Helianthium tenellum* (Mart.) Britton. Lake Zotz, *Lundell* 3293. Small herb; occasional in the fern and sedge bog of Lake Zotz.

## GRAMINEÆ

*Andropogon bicornis* L. Lake Zotz, *Lundell* 3316. Coarse perennial; occasional in the fern and sedge bog of Lake Zotz.

*Andropogon condensatus* HBK. Chachihuhe. Kantetul, *Lundell* 3169. Perennial 1 meter high; dominant grass in the Kantetul savanna.

*Arthrostylidium pittieri* Hack. Fisga. Naachtun, *Lundell* 1140; Uaxactun, *Bartlett* 12154. Woody, clambering, 2 to 4 meters high; forms dense thickets in climax forest.

*Bouteloua triæna* (Spreng.) Scribn. Tayasal, *Lundell* 3860. Perennial; common in grasslands.

*Cenchrus brownii* Roem. & Schult. El Paso, *Lundell* 1541. Annual; common in clearings.

*Cynodon dactylon* (L.) Pers. El Paso. Perennial; common in clearings.

*Digitaria horizontalis* Willd. El Paso, *Lundell* 1468. Annual; common in clearings.

*Digitaria sanguinalis* (L.) Scop. El Paso, *Lundell* 1534. Annual; common in clearings.

*Eleusine indica* (L.) Gærtn. El Paso, *Lundell* 1602; Flores, *Lundell* 3856. Annual; common in clearings.

*Eragrostis ciliaris* (L.) R. Br. Flores, *Lundell* 3855. Annual; common in clearings.

*Ichnanthus pallens* (Sw.) Munro. Uaxactun, *Bartlett* 12330. Perennial; common in climax forest.

*Imperata contracta* (HBK.) Hitchc. Ac. Kantetul, *Lundell* 3167. Coarse perennial 1 meter high; common in the savanna at Kantetul. Used widely for stuffing pack saddles and for thatching.

*Lasiacis divaricata* (L.) Hitchc. El Paso, *Lundell* 1587. Woody, clambering, 2 to 4 meters high; common in secondary upland forest.

*Lasiacis grisebachii* (Nash) Hitchc. Uaxactun, *Bartlett* 12190. Perennial; occasional in climax forest on the hills.

*Lasiacis ruscifolia* (HBK.) Hitchc. Tayasal, *Lundell* 3861; Macanche, on Yaxha-Remate road, *Lundell* 3862. Perennial; common in secondary upland forest.

*Leptochloa virgata* (L.) Beauv. Uaxactun, *Bartlett* 12760. Perennial; common on the ruins.

*Lithachne pauciflora* (Sw.) Beauv. La Libertad-Flores road, *Lundell* 3863. Perennial; occasional in secondary upland forest.

*Olyra latifolia* L. Without locality, *Cook & Martin* 116. Perennial 2 to 3 meters high; occasional in secondary upland forest.

*Olyra yucatana* Chase. El Paso, *Lundell* 1574; Uaxactun, *Bartlett* 12167. Perennial 1 to 1.5 meters high; occasional in upland forest.

*Oplismenus hirtellus* (L.) Beauv. El Paso, *Lundell* 1594; Uaxactun, *Bartlett* 12281. Perennial; common in forest, clearings, and open areas such as stream beds.

*Panicum bartlettii* Swallen. Uaxactun, *Bartlett* 12245. Perennial; common in swampy areas, especially on wet banks of streams and lakes.

*Panicum boliviense* Hack. San Pedro de Martir River, *Lundell* 1474. Perennial; common on river banks.

*Panicum fasciculatum* Sw. Tayasal. *Lundell* 3859. Perennial; common in grasslands.

*Panicum pilosum* Sw. La Libertad-Flores road, *Lundell* 3854. Perennial; occasional in clearings.

*Panicum reptans* L. El Paso, *Lundell* 1535. Annual; occasional in clearings.

*Panicum schiffneri* Hack. Uaxactun, *Bartlett* 12209. Perennial; occasional in Arroyo Uaxactun on sandy beds.

*Panicum trichanthum* Nees. El Paso, *Lundell* 1538; Lake Zotz, *Lundell* 3307. Perennial; very common on wet lake and river banks.

*Paspalum cæspitosum* Fl. La Libertad-Flores road, *Lundell* 3858. Perennial; occasional in clearings.

*Paspalum langei* (Fourn.) Nash. *Lundell 1552*. Perennial; common in clearings on wet soils.  
*Pentarrhaphis scabra* HBK. Sabana Zis, *Lundell 3196*. Perennial; common in Sabana Zis on outcropping limestone.

*Pharus parvifolius* Nash. Yaxha-Remate road, *Lundell 2014*. Perennial; apparently rare, growing in climax forest.

*Phragmites communis* Trin. Colahuete, Carrizo. Lake Petén, *Lundell 3120*; Lake Zotz, *Lundell 3311*. Perennial 2 to 3 meters high; common in lakes.

*Saccharum officinarum* L. Caña de azúcar. Lake Petén. Perennial; planted commonly around Lake Petén; one of the important local crops.

*Trichachne insularis* (L.) Nees. Uaxactun, *Bartlett 12688*. Perennial; common in clearings.

*Zea mays* L. Ixim, Maiz. Annual; cultivated extensively.

#### CYPERACEÆ

*Cladium jamaicense* Crantz. Saibal. San Felipe, Campeche, *Lundell 1439*; Lake Petén, *Lundell 3119*; without locality, *Cook & Martin 190*. Perennial 2 to 3 meters high; one of the dominant aquatics in aguadas, lakes, and streams.

*Cyperus articulatus* L. Lake Petén, *Lundell 3218*; Lake Zotz, *Lundell 3321*. Perennial; common in lakes.

*Cyperus diffusus* Vahl. San Pedro de Martir River, *Lundell 1475*. Perennial; common along river banks.

*Cyperus erythrorhizos* Muhl. Uaxactun, *Bartlett 12779*. Perennial; common on wet aguada banks.

*Cyperus ochraceus* Vahl. Uaxactun, *Bartlett 12778*. Perennial; common on wet aguada banks.

*Cyperus oxycarioides* Britton. El Paso, *Lundell 1548*; Remate, *Lundell 2091*; Nictun, Lake Petén, *Lundell 3155*; Uaxactun, *Bartlett 12769*. Perennial; common on wet aguada, stream, and lake banks.

*Cyperus tenerrimus* Presl. El Paso, *Lundell 1604*; Remate, *Lundell 2086*. Perennial; common in clearings on wet banks of rivers and lakes.

*Cyperus virens* Michx. El Paso, *Lundell 1606*. Perennial; common along rivers in marshy areas.

*Dichromena colorata* (L.) Hitchc. Nictun, Lake Petén, *Lundell 3147*. Annual; common in clearings on wet soils.

*Eleocharis caribæa* (Rottb.) Blake. Remate, *Lundell 2018*; Fallabon, *Lundell 2152*; Nictun, Lake Petén, *Lundell 3141*; San Jose, *Lundell 3220*. Small perennial; common on wet banks of lakes and streams.

*Eleocharis interstincta* (Vahl) R. & S. Polol, Polol macho. Lake Zotz, *Lundell 3326*; Lake Petén, *Lundell 3974, 3975*. Perennial; common in lakes, ranking next to *Cladium jamaicense* in abundance.

*Eleocharis plicarhachis* (Griseb.) Svenson. Lake Zotz, *Lundell 3325*. Perennial; very common in the fern and sedge bog of Lake Zotz.

*Eleocharis retroflexa* (Poir.) Urban. Naachtun, *Lundell 1143*. Perennial; common on wet banks of aguadas.

*Fimbristylis miliacea* (L.) Vahl. El Paso, *Lundell 1605*. Annual; common on wet soils in clearings.

*Fuirena incompleta* Nees. Tubux. Nictun, Lake Petén, *Lundell 3126*. Annual; common on wet soils in open areas.

*Fuirena simplex* Vahl. Naachtun, *Lundell 1142*. Perennial; common on wet banks of aguadas.

*Fuirena umbellata* Rottb. Lake Zotz, *Lundell 3292, 3979*. Perennial; common in the fern and sedge bog of Lake Zotz.

*Kyllinga pumila* Michx. El Paso, *Lundell 1603*. Annual; common in clearings.

*Rynchospora cephalotes* (L.) Vahl. Isabelita, *Lundell 1440*; Kantetul-San Andres road, *Lundell 3164*; without locality, *Cook & Martin 90*. Perennial; common in forest on wet soils. In bajos it is abundant, and may be considered the characteristic herb.

*Rynchospora corymbosa* (L.) Britton. Lake Zotz, *Lundell 3304*. Perennial; common on wet soils around the lakes.

*Rynchospora cyperoides* (Sw.) Mart. Aac. Naachtun, *Lundell 1137*; without locality, *Cook & Martin 82*. Perennial; common in swamp forest.

*Scirpus cubensis* Kunth. Lake Zotz, *Lundell 3322*. Perennial; common in the fern and sedge bog of Lake Zotz.



*Scleria bracteata* Cav. Naachtun, *Lundell 1163*. Subscandent, saw-toothed perennial 1 to 2.5 meters high; common in swamps. The species grows so abundantly in the logwood swamp north of Naachtun that passage through the area is a painful task.

*Scleria eggersiana* Boeck. Lake Zotz, *Lundell 3312*. Perennial 1.5 meters high; common on the banks of Lake Zotz.

*Scleria lithosperma* (L.) Sw. Dos Arroyos, *Bartlett 12100*. Perennial; common along roads through swamps.

*Scleria melaleuca* Schl. & Cham. La Libertad-Flores road, *Lundell 3977*. Perennial; common in upland forest.

*Scleria* sp. Lake Zotz, *Lundell 3317*. Perennial; occasional in the fern and sedge bog of Lake Zotz.

## PALMÆ

*Bactris* sp. El Paso, *Lundell 1522*. A palm 2 to 4 meters high, forming dense thickets along river banks. Kernels of the fruits are edible, being similar to coconut in flavor.

Several other species of *Bactris* occur in Northern Petén.

*Chamædorea elegans* Mart. (?). Uaxactun, *Bartlett 12166*. A small slender palm 1 to 2 meters high; common in climax forest.

*Chamædorea* spp. Perhaps a half-dozen additional species are represented by collections of Bartlett and the writer from Northern Petén.

*Cocos nucifera* L. Coco. Flores, Lake Petén. Planted to a limited extent for fruit and ornament.

*Cryosophila argentea* Bartlett. Escoba. Uaxactun, *Bartlett 12577*. A slender thorny palm 2 to 8 meters in height; common in swamps, forming the *escoba* association. In some localities, the species is common in climax forest.

*Desmoncus ferox* Bartlett. Tikal, *Bartlett 12584*, type collection. Spiny, clambering palm; type collected in forest on the wet banks of an *aguada* near Tikal.

*Desmoncus lundellii* Bartlett. Bayal. El Paso, *Lundell 1555*, type collection. Spiny, clambering palm; collected in a low wet place in secondary upland forest.

*Desmoncus uaxactunensis* Bartlett. Uaxactun, *Bartlett 12576*, type collection. Spiny, clambering palm; occasional in the forest along Arroyo Uaxactun (*botanal*).

Strips of *Desmonci* stems are used for basket making.

*Opsiandra maya* Cook. Cambo. Uaxactun, *Bartlett 12423*. Unarmed palm 3 to 8 meters high; common on sites of Maya ruins and along stream banks.

*Orbignya cohune* (Mart.) Dahlgren. Corozo. Giant magnificent palm 5 to 30 meters high; common in moist valleys and on stream banks. The rich oily kernels are eaten raw or boiled to extract the oil.

*Sabal mexicana* Mart. Huano de sombrero. San Andres. Tree with thick trunk, 4 to 8 meters high; planted in villages. I have never encountered the species growing wild in the Yucatan Peninsula. The young leaves are used extensively by the Indians for making hats.

*Sabal* sp. (*S. morrisiana* Bartlett, ined.) Botan. Uaxactun, *Bartlett 12284*. Graceful, slender palm 4 to 25 meters high; common in marginal areas of swamp forest (*botanal*), around *aguadas*, and in climax forest. In the swamps it towers over all the other vegetation, while in the climax forest it belongs to the middle tree tier reaching a maximum height of about 25 meters. The leaves of this species are prized above all others for thatching, and the tree is generally saved when *milpa* clearings are made in climax forest.

## BROMELIACEÆ

*Æchmea bracteata* (Sw.) Griseb. Izchu, Chuek. Uaxactun, *Bartlett 12196*. A large coarse epiphyte; very common in all habitats.

*Æchmea kienastii* E. Morr. Pie de gallo. El Paso, *Lundell 1637*. An epiphyte; rare.

*Æchmea magdalenæ* Andre. Pita. Tikal, *Bartlett 12640*. Large coarse terrestrial 1.5 meters high; common on wet *aguada* banks.

*Æchmea bromeliæfolia* (Rudge) Bak. Yaxha-Remate road, *Lundell 4275*. A whitish-gray scurfy epiphyte; occasional in forest. (Living plants in Botanical Garden, University of Michigan.)

*Ananas comosus* (L.) Merrill. Piña. Coarse terrestrial 1 meter high; cultivated.

*Bromelia karatas* L. *Piñuela*. Coarse terrestrial 1.5 to 2 meters high. Common in the Central Petén Savanna Country and future botanical exploration will certainly reveal that it grows in Northern Petén. The small edible acid fruits are much prized locally.

*Bromelia pinguin* L. *Ixchuu*. Yaloch-El Cayo road, *Bartlett 12863*. Coarse terrestrial 1 meter high; occasional. The very acid fruits are edible.

*Catopsis bakeri* Mez. Uaxactun, *Bartlett 12288, 12289*. An epiphyte; common on the ruins.

*Pitcairnia recurvata* (Scheidw.) C. Koch. *Azucena silvestre*. San Andres, *Lundell 3217*. Coarse terrestrial about 1 meter high; common on the steep limestone cliffs along the north shore of Lake Petén.

*Tillandsia balbisiana* Schult. f. *Topoxte*, *Lundell 3960*; Uaxactun, *Bartlett 12515*. A small epiphyte; common in swamp forest and climax forest.

*Tillandsia brachycaulos* Schdl. Uaxactun, *Bartlett 12514*. An epiphyte; occasional in swamp forest.

*Tillandsia bulbosa* Hook. *Holunzial*. Reported by Standley in the *Flora of Yucatan* as being known from Petén.

*Tillandsia festucoides* Brongn. Uaxactun, *Bartlett 12144*. An epiphyte; occasional in forest.

*Tillandsia juncea* Le C. Uaxactun, *Bartlett 12286, 12512*. An epiphyte; common on trees among the ruins.

*Tillandsia polystachya* L. *Ixchuec*. Uaxactun, *Bartlett 12169, 12513*. An epiphyte; common in climax forest and on trees among the ruins.

*Tillandsia schiedeana* Steud. Uaxactun, *Bartlett 12287*; Tikal, *Bartlett 12651*. An epiphyte; common on trees among the ruins.

*Tillandsia usneoides* L. *Umeez nohoch uinic*, *Paste*. Uaxactun, *Bartlett 12226*; Yaxha, *Lundell 2210*. Small epiphyte; common in certain localities.

*Tillandsia valenzuelana* A. Rich. Uaxactun, *Bartlett 12147, 12323, 12417*; Tikal, *Bartlett 12657, 12586*. An epiphyte; common in the forest and on trees among the ruins.

*Vriesia gladioliflora* (Wendl.) Ant. Dos Arroyos-Yaloch road, *Bartlett 12851*. Large unarmed epiphyte; rare.

#### LEMNACEÆ

*Lemna cyclostasa* (Ell.) Chev. Without locality, *Cook & Martin 137*.

*Lemna polyrrhiza* L. Without locality, *Cook & Martin 138*.

*Wolffia* sp. These small aquatic plants grow abundantly in the *aguadas*.

#### ARACEÆ

*Anthurium æmulum* Schott. Naachtun, *Lundell 1160*; Uaxactun, *Bartlett 12269*. Root-climbing epiphytic vine; common on tree trunks in climax forest.

*Anthurium tetragonum* Hook. var. *yucatanense* Engl. El Paso, *Lundell 1573*; Uaxactun, *Bartlett 12295, 12296*. Terrestrial or epiphytic plants 1 meter high; common on limestone ledges in open hill forest, on the ruins, and as an epiphyte on forest trees.

*Monstera* sp. Uaxactun, *Bartlett 12744*. Giant, root-climbing epiphytic vine; common on tree trunks in mesophytic areas. Species of this genus are very conspicuous in the Northern Petén forest.

*Monstera* sp. Uaxactun, *Bartlett 12745*. A large vine with the same habit as the former species.

*Philodendron smithii* Engl. *Chuyucac*. Uaxactun, *Bartlett 12426*; El Paso, *Lundell 1572*. An epiphyte; common in climax forest.

*Pistia stratiotes* L. *Xicinchah*. Lake Petén, *Aguilar 160*. Floating aquatic; common in *aguadas*, lakes, and streams.

*Syngonium podophyllum* Schott. Epiphytic vine; common in open climax forest.

*Syngonium* sp. Uaxactun, *Bartlett 12664*. Epiphytic vine.

*Xanthosoma yucatanense* Engl. Large terrestrial 1 meter high; common in the dry bed of Arroyo Uaxactun. (Living plants in Botanical Garden, University of Michigan.)

#### COMMELINACEÆ

*Commelina elegans* HBK. Uaxactun, *Bartlett 12548*. A fleshy perennial herb; common in clearings, occasional in climax forest.

*Dichorisandra hexandra* (Aubl.) Standl. (?). Naachtun, *Lundell 1141*. A fleshy perennial herb; encountered once along a trail in climax forest.

*Neodonnellia grandiflora* (Donn. Sm.) Rose. *Hoja de fluxion*. El Paso, *Lundell 1595*; Santa Cruz, *Bartlett 12390*; Tikal, *Bartlett 12647*. A fleshy herbaceous vine with exceedingly fragrant flowers; common in climax forest, and cultivated for ornament. The writer's Campeche collections of this species were distributed as *Tradescantia lundellii* Standl., an herbarium name.

*Rhæo discolor* (L'Hér.) Hance. *Chactsam*. Uaxactun, *Bartlett 12701*; without locality, *Cook & Martin 72*. A fleshy perennial; very common on the ruins.

*Tradescantia cordifolia* Sw. Uaxactun, *Bartlett 12174*. A small creeping perennial; common in clearings, generally in wet places.

*Tradescantia geniculata* Jacq. Uaxactun, *Bartlett 12320*. A small creeping herb; occasional in secondary upland forest.

## PONTEDERIACEÆ

*Eichhornia crassipes* (Mart.) Solms. *Ninfa*. The water hyacinth grows abundantly in Lake Pétén.

*Pontederia lanceolata* Nutt. Isabelita-El Paso trail, *Lundell 1445*. An aquatic; occasional in streams.

*Pontederia rotundifolia* L. El Paso, *Lundell 1564*. An aquatic; common in the San Pedro de Martir River.

## LILIACEÆ

*Dracæna americana* Donn. Sm. *Halal, Ilcaax, Cerbatana*. Tikal, *Bartlett 12606*; Uaxactun-San Clemente trail, *Bartlett 12797*; without locality, *Cook & Martin 66*. Small tree 4 to 8 meters high; occasional in climax forest.

## SMILACACEÆ

*Smilax aristolochiæfolia* Mill. *Cocomeca*. Uaxactun, *Bartlett 12337*. A slender woody vine; occasional in climax forest and swamp forest (*botanal*).

*Smilax lundellii* Killip & Morton. *Zarza*. Sabana Zis, *Lundell 3190*, type collection. A slender, somewhat woody vine; encountered once in marginal forest around Sabana Zis.

*Smilax mollis* H. & B. Uaxactun, *Bartlett 12331*. A slender vine; occasional in climax forest and swamp forest (*botanal*).

*Smilax regelii* Killip & Morton. *Zarzaparrilla*. Tikal, *Cook & Martin 214*.

## DIOSCOREACEÆ

*Dioscorea bartlettii* Morton. *Cocomeca, Cocomeca blanco*. Uaxactun, *Bartlett 12140, 12425*; Uaxactun-San Clemente trail, *Bartlett 12813*. Large liana; occasional in swamp forest (*botanal*) and climax forest (*caobal*).

*Dioscorea bernoulliana* Prain & Burkill. Uaxactun, *Bartlett 12292*. Slender vine; occasional in secondary upland forest.

*Dioscorea matagalpensis* Uline. Uaxactun, *Bartlett 12138, 12353*. Slender vine; occasional in secondary upland forest.

## AMARYLLIDACEÆ

*Agave* sp. *Ucihil chelem*. Dos Arroyos-Yaloch road, *Bartlett 12850*. Collected in swamp forest.

## MUSACEÆ

*Musa paradisiaca* L. *Platano*. Cultivated extensively.

*Musa sapientum* L. *Guineo*. Cultivated extensively.

*Heliconia* spp. Coarse perennials; common in open areas on moist lake and stream banks.

## CANNACEÆ

*Canna edulis* Ker. (?). Uaxactun, *Bartlett 12131*. Coarse herb.

*Canna indica* L. (?) Without locality, *Cook & Martin 50*.

## ZINGIBERACEÆ

*Renealmia* sp. Yaxha-Fallabon road, *Lundell 4296*. Tall coarse herb, growing in wet soil in a *corozal*.

*Renalmia aromatica* (Aubl.) Griseb. (?). Nabay. Without locality, Cook & Martin 130. Large coarse herb.

*Renalmia occidentalis* (Sw.) Sweet (?). Uaxactun, Bartlett 12450; Tikal, Bartlett 12601. Large coarse herb; occasional on wet *aguada* banks and in low places in upland forest.

#### MARANTACEÆ

*Calathea lutea* (Aubl.) Mey. Tikal, Bartlett 12585. Large coarse herb; common in open areas in low moist places.

*Thalia geniculata* L. Lake Zotz, Lundell 3300; without locality, Cook & Martin 71. Tall herb; common in the fern and sedge bog of Lake Zotz.

#### ORCHIDACEÆ

*Bletia tuberosa* (L.) Ames. Lake Zotz, Lundell 3323. Bulbous perennial; common in the fern and sedge bog of Lake Zotz.

*Brassia maculata* R. Br. Uaxactun, Bartlett 12699. An epiphyte; collected in swamp forest.

*Brassia* sp. Tikal, Bartlett 12659. An epiphyte.

*Epidendrum aciculare* Batem. Uaxactun-San Clemente trail, Bartlett 12804. An epiphyte.

*Epidendrum alatum* Batem. San Andres, Lundell 3130. An epiphyte.

*Epidendrum cochleatum* L. Tikal, Bartlett 12588; Uaxactun, Bartlett 12742. An epiphyte; common in forest.

*Epidendrum imatophyllum* Lindl. El Paso, Lundell 1500; Uaxactun, Bartlett 12322, 12669. An epiphyte; common.

*Epidendrum paleaceum* (Lindl.) Rehb. f. Uaxactun, Bartlett 12422. An epiphyte; apparently rare.

*Erythroxes vaginata* (Hook.) Ames. Tikal, Bartlett 12613. Collected on a mossy log.

*Habenaria pringlei* Robins. Lake Zotz, Lundell 3324. An attractive plant; occasional in the fern and sedge bog of Lake Zotz.

*Ionopsis utricularioides* (Sw.) Lindl. Ixlu, Lundell 3398. An epiphyte; common in forest.

*Maxillaria tenuifolia* Lindl. Tikal, Bartlett 12645; Uaxactun-San Clemente trail, Bartlett 12796. An epiphyte.

*Maxillaria uncata* Lindl. Uaxactun, Bartlett 12436. An epiphyte.

*Notylia trisepala* Lindl. & Paxt. Yaxha, Lundell 3899. An epiphyte.

*Oncidium ascendens* Lindl. Uaxactun, Bartlett 12208. An epiphyte.

*Oncidium sphacelatum* Lindl. Uaxactun, Bartlett 12344, 12538; Tikal, Bartlett 12653. An epiphyte.

*Pleurothallis brighami* Wats. (?). Naachtun, Lundell 1158; San Clemente-Dos Arroyos trail, Bartlett 12816. An epiphyte.

*Pleurothallis stenostachya* Rehb. f. Naachtun, Lundell 1156. An epiphyte; occasional on tree trunks.

*Ponera striata* Lindl. Uaxactun, Bartlett 12277. An epiphyte.

*Sarcoglottis picta* (Anders.) Kl. San Clemente, Bartlett 12119. Terrestrial; occasional in swamp forest.

*Spiranthes costaricensis* Rehb. f. Uaxactun, Bartlett 12202. Terrestrial; occasional in climax forest.

*Spiranthes cranichoides* Cogn. Tikal, Bartlett 12614; Yaloch-El Cayo road, Bartlett 12861. On mossy logs in forest.

*Spiranthes elata* (Sw.) Rich. (?). Without locality, Cook & Martin 70.

*Stenorrhynchus orchiodes* (Sw.) L. C. Rich. Sabana Tzimintun, Lundell 3134; La Libertad-Flores road, Lundell 3896; Tayasal, Lundell 3897. Terrestrial plant with clustered fleshy roots; quite conspicuous in savannas, but rare elsewhere.

*Trigonidium egertonianum* Batem. Uaxactun, Bartlett 12437. An epiphyte; common.

*Vanilla fragrans* (Salisb.) Ames. San Andres, Lundell 3236. A large fleshy vine; not common, although widely distributed through climax forest.

#### PIPERACEÆ

*Peperomia chucanebana* Trel. El Paso, Lundell 1578. Small scandent epiphyte; common in climax forest.

- Peperomia cobana* C. DC. Uaxactun, Bartlett 12279. An epiphyte in climax forest.
- Peperomia cubilquitziana* Trel. Tikal, Bartlett 12583. An epiphyte.
- Peperomia glutinosa* Millsp. El Paso, Lundell 1575. Small climbing epiphyte; common in climax forest.
- Peperomia gollii* Trel. Chunupcaac. Without locality, Cook & Martin 73.
- Peperomia lundellii* Trel. El Paso, Lundell 1625. Fleshy epiphyte; common in climax forest.
- Peperomia martini* Trel. Uaxactun, Bartlett 12207. Collected on a rock in the forest along Arroyo Uaxactun.
- Peperomia polochicana* Trel. El Paso, Lundell 1626; Fallabon-Yaxha road, Lundell 2191; Uaxactun, Bartlett 12150, 12316. An epiphyte; common in swamp forest, occasional elsewhere.
- Peperomia quicheensis* Trel. Uaxactun, Bartlett 12206. Collected on a rock in the forest along Arroyo Uaxactun.
- Peperomia quiriguana* Trel. Zecalchan. Uaxactun, Bartlett 12149, 12185, 12312. An epiphyte.
- Piper andresense* Trel. San Andres, Lundell 3203, type collection. A shrub growing in the inhabited clearing.
- Piper andresense* Trel. var. *subcalvescens* Trel. Yaxha, Lundell 2011, type collection. A shrub growing abundantly in the village of Yaxha.
- Piper auritum* HBK. El Paso, Lundell 1491. A large suffrutescent plant often 3 meters high; common around inhabited clearings in young secondary bush.
- Piper auritum* HBK. var. *amplifolium* C. DC. Uaxactun, Bartlett 12193. Common in young secondary bush.
- Piper cobanense* Trel. Cuchiuxu, Uaxactun, Bartlett 12170, 12313, 12459, 12509, 12522, 12565. A shrub as much as 6 cm. in diameter and ranging from 2 to 4 meters in height; common in climax forest, occasional in swamp forest.
- Piper colaphitolerans* Trel. Ixlu, Lundell 3827, type collection. A shrub 3 meters high; common in climax forest.
- Piper curvatipes* Trel. Nictun, Lake Petén, Lundell 3122, type collection. A shrub 1 to 2 meters high.
- Piper kantetulense* Trel. Kantetul, Lundell 3173, type collection. A shrub 2 to 4 meters high; common in the secondary scrub forest overrunning Sabana Kantetul.
- Piper multinervium* Mart. & Gal. Kantetul, Lundell 3168. A shrub 2 to 4 meters high; common in the secondary scrub forest overrunning Sabana Kantetul.
- Piper nitidulifolium* Trel. El Paso, Lundell 1486. A shrub 3 meters high; common in climax forest.
- Piper nitidulilaminum* Trel. Remate, Lundell 2077, type collection. A shrub 2 to 3 meters high; common in small clumps of young secondary bush within the confines of the village.
- Piper psilorhache* C. DC. El Paso, Lundell 1484, 1485. A shrub 2 to 3 meters high; very common in climax forest, occasional in swamp forest.
- Piper quadratilimum* Trel. El Paso, Lundell 1488, type collection. A shrub 2 to 4 meters high; common in climax forest.
- Piper rematense* Trel. Remate, Lundell 2087, type collection. A shrub 1 to 3 meters high.
- Piper sempervirens* (Trel.) Lundell. Uaxactun, Bartlett 12326, 12563, 12683; Ixlu, Lundell 3828.
- Piper simulhabitans* Trel. Remate, Lundell 2073, type collection. A shrub 2 to 3 meters high; common in secondary bush near the village.
- Piper stevensonii* Trel. (?). El Paso, Lundell 1462. A shrub 2 to 4 meters high; common in climax forest.
- Piper tikalense* Trel. Tikal, Bartlett 12595, type collection. A shrub 2 to 3 meters high; common in the forest covering the ruins.
- Piper villipetiolatum* Trel. Uaxactun, Bartlett 12192, 12274, 12562; Santa Cruz, Bartlett 12362. A shrub 2 to 4 meters high; common in secondary upland forest.
- Piper yaxhanum* Trel. Yaxha-Remate road, Lundell 3826, type collection. A shrub about 2 meters high; common along the road in forest shade.
- Piper yucatanense* C. DC. El Paso, Lundell 1487. A shrub about 2 meters high; common in climax forest.

*Cordoncillo* is the vernacular name for all of the species of *Piper*.

#### FAGACEÆ

*Quercus oleoides* Cham. & Schl. var. *australis* Trel. Dos Arroyos, Bartlett 12112. A tree 30 cm. in diameter; collected in swamp forest. Rare in Northern Petén, but common in the pine country of British Honduras.

## ULMACEÆ

*Celtis hottlei* Standl. *Lwin*. Uaxactun, *Bartlett* 12532, 12766. A tree 30 cm. in diameter, growing in swamp forest.

*Celtis trinervia* Lam. Topoxte, *Lundell* 4306; Uaxactun, *Bartlett* 12574. A slender tree 6 to 10 meters in height; collected in climax forest covering the ruins of Topoxte, and in secondary bush at Uaxactun.

*Trema floridana* Britton. *Capolin cimarron*. Yaloch, *Bartlett* 12856. A small tree as much as 10 cm. in diameter; common in secondary upland forest covering abandoned *milpas*.

## MORACEÆ

*Artocarpus communis* Forst. El Paso. Planted to a limited extent, chiefly for shade.

*Brosimum alicastrum* Sw. *Ox*, *Ramon*, *Ramon blanco*. Uaxactun, *Bartlett* 12307; without locality, *Cook & Martin* 140. A tree as much as 90 cm. in diameter and 30 meters in height; widely distributed through climax forest, but most abundant on the sites of Maya ruins where it occurs in groves known as *ramonales*. The leaves and small twigs are excellent forage, hence the tree is of much importance to the chicle industry and all commerce in general which depends on mule transportation.

*Castilla elastica* Cerv. *Ule*. Tikal, *Bartlett* 12639. A tall erect tree 30 cm. in diameter, growing in forest covering the ruins. Within the past three decades various archæological expeditions have cleared areas of the forest covering the ruins of Tikal, hence much of the bush there must be entirely secondary.

*Cecropia* sp. Lake Zotz, *Lundell* 3295, 3296. Slender trees 4 to 8 meters in height; the species characterizes young secondary growth in abandoned *milpas*.

*Cecropia mexicana* Hemsl. This species was seen growing in climax forest, but it was not collected. It is a tree 20 to 60 cm. in diameter reaching a height of 25 meters.

*Chlorophora tinctoria* (L.) Gaud. *Mora*. Uaxactun, *Bartlett* 12575. A small tree; collected in swamp forest; generally found around villages in secondary bush.

*Coussapoa oligocephala* Donn. Sm. *Higo*. San Andres, *Lundell* 3170. A tree 12 meters high, growing on the steep limestone slopes along the north shore of Lake Petén.

*Dorstenia contrajerva* L. *Cambahan*, *Yerba sapo*, *Contrayerba*, *Contrajerva*. Tayasal, *Lundell* 4256, 4257; Uaxactun, *Bartlett* 12199, 12273; without locality, *Cook & Martin* 134, 145, 146. Small perennial herb; common in climax forest, secondary upland forest, and clearings.

Several varieties are represented by the collections, but they are scarcely worthy of recognition. The species is quite variable, and all intergradations between the varieties may be found in one locality.

*Ficus kellermanii* Standl. (?). Uaxactun, *Bartlett* 12693. A seedling collected in the forest near Uaxactun.

*Ficus lapathifolia* (Liebm.) Miq. Uaxactun, *Bartlett* 12746. A tree 150 cm. in diameter; very common in forest covering ruins, and responsible for much destruction of monuments and buildings.

*Higo*, *copo*, and *mata palo* are the vernacular names commonly applied to the strangler figs.

*Ficus cerstediana* Miq. Fallabon-Yaxha road, *Lundell* 2200. A large tree 15 meters in height, growing in climax forest.

*Ficus radula* Willd. San Andres, *Lundell* 3181. A large tree 8 to 15 meters high; collected in climax forest and in secondary upland forest; generally common around lakes.

*Ficus segoviae* Miq. Lake Zotz, *Lundell* 3274. A tree 40 cm. in diameter and 12 meters high, growing on lake banks.

*Ficus tuerckheimii* Standl. Lake Zotz, *Lundell* 3275. A tree 50 cm. in diameter and 15 meters high, growing on lake banks.

*Ficus velutina* Willd. (?). Uaxactun, *Bartlett* 12692. A seedling collected in the forest near Uaxactun.

*Pseudolmedia spuria* (Sw.) Griseb. *Manax*. Uaxactun, *Bartlett* 12549. A tree reaching a diameter of 50 cm. and a height of 18 meters; widely distributed in climax forest. It is so common in some areas that the forest association is designated locally as a *manaxal*. The small edible cherry-like fruits are of excellent quality.

*Pseudolmedia oxyphyllaria* Donn. Sm. *Manax*. Uaxactun, *Bartlett* 12227. A tree very similar to the former species in habit and distribution.

*Trophis racemosa* (L.) Urb. *Catalox*, *Ramon colorado*. Santa Cruz, *Bartlett* 12375. A tree 15 cm. in diameter and 12 meters high; common in secondary upland forest.

## URTICACEÆ

*Bahmeria ulmifolia* Wedd. Uaxactun, *Bartlett* 12280, 12309. A suffrutescent plant 2 to 3 meters high, growing in the dry bed of Arroyo Uaxactun.

*Laportea mexicana* (Liebm.) Miq. *Lah.* Uaxactun, *Bartlett* 12763. A shrub; occasional on steep limestone slopes in open hill forest.

*Myriocarpa obovata* Donn. Sm. Fallabon-Yaxha road, *Lundell* 2194. A slender tree about 8 meters high; occasional in climax forest.

*Pouzolzia obliqua* Wedd. La Libertad-Flores road, *Lundell* 4339. A shrub; occasional in secondary forest.

*Rousseelia humilis* (Sw.) Urb. Uaxactun, *Bartlett* 12161. A small annual, growing in the dry sandy bed of Arroyo Uaxactun.

*Urera baccifera* (L.) Gaud. *Lah.* Uaxactun, *Bartlett* 12520. A shrub 6 cm. in diameter and 3 meters high, growing on steep limestone slopes in open hill forest.

## LORANTHACEÆ

*Phoradendron aurantiacum* Trel. *Kimiche, Mata palo.* Sabana Zis, *Lundell* 3191, type collection. A crown parasite; collected on a tree in the open savanna.

*Phoradendron cheiroparpum* Trel. Yaxmoxan on Yaxha-Remate road, *Lundell* 3832; Uaxactun, *Bartlett* 12357. A crown parasite; collected on *Lucuma* and *Sideroxylon*.

*Phoradendron piperoides* (HBK.) Trel. San Andres, *Lundell* 3186. A crown parasite; collected on trees in secondary upland forest.

*Struthanthus orbicularis* (HBK.) Blume. El Paso, *Lundell* 1496. A woody parasitic vine often completely covering crowns of trees. Its small yellow flowers are very fragrant.

## BALANOPHORACEÆ

*Helosis mexicana* Liebm. Tikal, *Cook & Martin* 167. A root parasite.

## OLACACEÆ

*Ximenia americana* L. *Abalche.* Kantetul, *Lundell* 3183. A thorny tree not more than 5 meters high and generally smaller; occasional in the scrub forest overrunning Sabana Kantetul. The small yellow plum-like fruits are edible.

## POLYGONACEÆ

*Coccoloba reflexiflora* Standl. Uaxactun-San Clemente road, *Bartlett* 12815. A small, gnarled, wiry tree about 10 cm. in diameter; common in the central areas of the *bajos (tintal)*. It is one of the characteristic swamp species, restricted to that habitat.

*Coccoloba schiedeana* Lindau. El Paso, *Lundell* 1498. A tree 12 meters high, growing on the wet banks of the river.

*Gymnopodium antigonoides* (Robinson) Blake. Uaxactun-San Clemente road, *Bartlett* 12811. A shrub 3 meters high; occasional in swamp forest.

*Gymnopodium floribundum* Rolfe. San Andres, *Lundell* 3139. A large liana, growing on the steep banks along the north shore of Lake Petén. The species is encountered generally on rocky declivities.

*Polygonum acuminatum* HBK. Lake Zotz, *Lundell* 3298. A slender herb, growing commonly around the edges of lakes; occasional in the fern and sedge bog of Lake Zotz.

## AMARANTHACEÆ

*Alternanthera brasiliensis* (L.) Kuntze. San Andres, *Lundell* 3199; Tayasal, *Lundell* 4255. An herb; common in clearings.

*Alternanthera obovata* (Mart. & Gal.) Standl. El Paso, *Lundell* 1507; Uaxactun, *Bartlett* 12448. A perennial herb of wet soils; collected in a clearing on the bank of the San Pedro de Martir River, and at the edge of an *aguada*.

*Alternanthera polygonoides* (L.) R. Br. Lake Zotz, *Lundell* 3314. Small prostrate herb; common weed in clearings.

*Amaranthus dubius* Mart. *Chic ixtez, Acilixtez.* Uaxactun, *Bartlett* 12524, 12572. An erect annual; common in clearings.



*Amaranthus spinosus* L. *Ixtez*. San Andres, *Lundell* 3179. A spiny succulent annual; common in inhabited clearings.

*Celosia nitida* Vahl. Uaxactun, *Bartlett* 12266, 12666. An erect wiry herb 1 to 2 meters high; common in clearings.

*Chamissoa altissima* (Jacq.) HBK. El Paso, *Lundell* 1466. A subscandent herb in abandoned clearings.

*Iresine celosia* L. El Paso, *Lundell* 1546; *Bartlett* 12523. A tall slender herb; common in clearings.

*Iresine nigra* Uline & Bray. Macanche, on Yaxha-Remate road, *Lundell* 4308. A slender wiry herb in secondary upland bush.

#### CHENOPODIACEÆ

*Chenopodium ambrosioides* L. *Apazote*. Flores, *Lundell* 3225. A large perennial herb; commonly planted for medicinal purposes.

#### NYCTAGINACEÆ

*Bærhoavia erecta* L. El Paso, *Lundell* 1582; Tayasal, *Lundell* 4260. A common weedy herb of clearings.

*Mirabilis jalapa* L. *Maravilla*. Santa Cruz, *Bartlett* 12381. A perennial herb; common around inhabited clearings where it grows as an escape.

*Mirabilis violacea* (L.) Heimerl. Flores, *Lundell* 4206. A weedy herb, growing within the city.

*Neea psychotrioides* Donn. Sm. Santa Cruz, *Bartlett* 12373. A shrub 2 meters high, growing in young secondary bush.

#### PHYTOLACCACEÆ

*Petiveria alliacea* L. *Yerba zorrillo*. Without locality, *Cook & Martin* 207.

*Phytolacca icosandra* L. Remate, *Lundell* 2089, 3241. A weedy herb; common in clearings.

*Rivina humilis* L. *Corubcanu*. El Paso, *Lundell* 1467; Ixlu, *Lundell* 4251; Uaxactun, *Bartlett* 12121, 12233; Santa Cruz, *Bartlett* 12384; without locality, *Cook & Martin* 83. A perennial herb; common in clearings.

#### PORTULACACEÆ

*Portulaca oleracea* L. *Verdolaga*. Uaxactun, *Bartlett* 12172. A weedy annual.

#### NYMPHÆACEÆ

*Cabomba aquatica* Aubl. El Paso, *Lundell* 1502; Fallabon, *Lundell* 2198. An aquatic herb; common in lakes and streams.

*Nymphæa ampla* (Salisb.) DC. *Naab*. El Paso, *Lundell* 1517; Lake Petén, *Lundell* 3240; Lake Zotz, *Lundell* 3313. An aquatic herb with large floating leaves and handsome showy white flowers; common in lakes and streams, characterizing the *naabal* association.

#### RANUNCULACEÆ

*Clematis dioica* L. *Chilpat*. Santa Cruz, *Bartlett* 12393. A woody vine; common in secondary upland forest.

#### MENISPERMACEÆ

*Cissampelos tomentosa* DC. El Paso, *Lundell* 1525; Yaloch, *Bartlett* 12853, 12857. A slender suffrutescent vine; common in recently abandoned clearings.

There is some question whether *C. tomentosa* is distinct from *C. pareira* L.

#### ANNONACEÆ

*Annona cherimola* Mill. *Chirimoya*. A small tree; cultivated for its fruits.

*Annona muricata* L. *Guanabana*. A small tree; cultivated for its fruits.

*Annona reticulata* L. (?). *Oopchi*. Gavilan on Fallabon-Yaxha road, *Lundell* 2213, 2215; Uaxactun, *Bartlett* 12474. A small tree, as much as 20 cm. in diameter and 8 meters high; culti-

vated for its fruits. Trees with small inedible fruits, growing wild in the upland forest, are at present being referred to this species; they may represent naturalized individuals with inferior fruit.

*Annona squamosa* L. *Zaramuya*. A small tree; cultivated for its fruits.

*Guatteria leiophylla* (Donn. Sm.) Safford. *Ecklemoy*. Naachtun, *Lundell 1157*; Nakum, *Cook & Martin 68*; Uaxactun, *Bartlett 12325*. A small tree, growing in climax forest and swamp forest.

*Malmea depressa* (Baill.) Fries. Uaxactun, *Bartlett 12234*. A small tree 15 cm. in diameter; occasional in climax forest.

*Sapranthus campechianus* (HBK.) Standl. *Nitxmaxche*. Without locality, *Cook & Martin 219*.

*Sapranthus microcarpus* (Donn. Sm.) Fries. Uaxactun, *Bartlett 12298*.

#### LAURACEÆ

*Cassytha filiformis* L. *Suelto con sueldo*. Nictun, *Lundell 3124*. A slender parasitic vine; not common.

*Misanteca campechiana* (Standl.) Lundell. *Copal-chi*. Uaxactun, *Bartlett 12339*. A tree 45 cm. in diameter; occasional in climax forest.

*Misanteca* sp. *Tzotzni*. Plancha Piedra, *Lundell 2216*; Uaxactun, *Bartlett 12214, 12236, 12550*. A large tree sometimes 60 cm. in diameter; occasional in climax forest.

*Nectandra sanguinea* Rottb. (?). *Aguacatillo, Laurel blanco*. El Paso, *Lundell 1528*; Uaxactun, *Bartlett 12198, 12335*. Generally a small tree, but sometimes reaching a height of 15 meters; common in climax forest, occasional in other forest habitats.

Several collections other than those listed above have been tentatively referred to this genus.

*Ocotea lundellii* Standl. *Yaaxhochoc, Laurel*. Sabana Zis, *Lundell 3195*; Ixlu, *Lundell 4359*, type collection. A tree 20 to 30 cm. in diameter and reaching a height of about 15 meters; occasional in climax forest and in the marginal forest surrounding savannas.

*Persea americana* Mill. *On, Aguacate*. A tree 4 to 8 meters high; commonly cultivated.

#### PAPAVERACEÆ

*Argemone mexicana* L. *Cardosanto*. Santa Cruz, *Bartlett 12369*; without locality, *Cook & Martin 183*. A common weedy herb of inhabited clearings.

*Bocconia frutescens* L. *Camotillo*. Santa Cruz, *Bartlett 12382*. Coarse herb 2 meters high.

#### CAPPARIDACEÆ

*Capparis baducca* L. San Andres, *Lundell 3132*. A woody vine; collected in secondary upland forest.

*Capparis cynophallophora* L. *Zic*. Uaxactun-San Clemente road, *Bartlett 12791*. Small tree, growing in the central area of a *bajo (tintal)*.

*Capparis flexuosa* L. *Potal*. San Andres, *Lundell 3129*. A large woody vine, growing along the bank on the north shore of Lake Petén.

*Capparis lundellii* Standl. San Andres, *Lundell 3115, 3201*, type collection. A small tree 3 to 6 meters high; discovered on the bank along the north shore of Lake Petén.

*Capparis tuerckheimii* Donn. Sm. El Paso, *Lundell 1499*. A tree 6 to 10 meters high, growing on low banks of the San Pedro de Martir River.

*Capparis verrucosa* Jacq. *Naranjillo*. Nakum, *Cook & Martin 85*. A shrub or small tree.

*Capparis* sp. Uaxactun, *Bartlett 12453*. A slender shrub 2 meters high, growing in climax forest.

*Cleome serrata* Jacq. El Paso, *Lundell 1576*; Pueblo Nuevo, Lake Petén, *Lundell 4204*. A common herb in clearings.

*Forchammeria trifoliata* Radlk. *Tres Marias*. Naachtun, *Lundell 1159*; Uaxactun, *Bartlett 12165*; without locality, *Cook & Martin 65*. A shrub or small tree; common in climax forest.

#### CRUCIFERÆ

*Lepidium virginicum* L. Uaxactun, *Bartlett 12687*. A small erect herb; very common in inhabited clearings.

#### ROSACEÆ

*Hirtella americana* L. *Aceituno*. Uaxactun, *Bartlett 12471, 12741*. A shrub or small tree 25 cm. in diameter with reddish wood; common in climax forest.

## LEGUMINOSÆ

*Acacia angustissima* (Mill.) Kuntze. Kantetul. A gnarled slender tree 4 to 8 meters high; common in savannas where it often occurs solitary.

*Acacia collinsii* Safford (?). Subin, Cornezuelo. Fallabon, Lundell 2150; Uaxactun, Bartlett 12578, 12676. A slender erect shrub or tree sometimes reaching a height of 10 meters; common in secondary upland forest, occasional in climax forest and swamp forest.

*Acacia cookii* Safford (?). Subin. Fallabon-Yaxha road, Lundell 2195, 2214; Yaxha, Lundell 2208. A shrub or slender tree; common in secondary upland forest, occasional in climax forest.

*Acacia cornigera* (L.) Willd. (?). Without locality, Cook & Martin 232.

*Acacia spadicigera* Schl. & Cham. El Paso, Lundell 1608. A slender erect shrub or small tree; occasional in secondary upland forest.

*Æschynomene deamii* Robins. & Bartlett. Zinzinacax. Uaxactun, Bartlett 12351. A shrub 4 meters high, growing in the aguada at Uaxactun.

*Bauhinia divaricata* L. Tsulutok, Pata de vaca. Uaxactun, Bartlett 12127, 12302, 12449, 12511, 12768; Yaloch, Bartlett 12859. A slender shrub; common in secondary upland forest and climax forest.

*Bauhinia glabra* Jacq. Uaxactun, Bartlett 12455. A woody vine 5 cm. in diameter, growing in swamp forest.

*Bauhinia jenningsii* P. Wilson. Ixacitz. Uaxactun, Bartlett 12145; Santa Cruz, Bartlett 12387. A slender treelet, 4 meters high; collected in swamp forest (botanal) and secondary upland forest.

*Cæsalpinia violacea* (Mill.) Standl. Cante. Uaxactun, Bartlett 12678. A large tree 60 cm. in diameter, growing in climax forest.

*Cæsalpinia yucatanensis* Greenm. Cinim, Palo de gusano. Santa Cruz, Bartlett 12405; San Clemente-Dos Arroyos road, Bartlett 12837. A small tree 15 cm. in diameter; collected in climax forest and secondary upland forest.

*Calliandra cookii* (Britt. & Rose) Standl. Yaxmoxan-Yaxha road, Cook & Martin 209, type collection. Apparently a slender shrub.

*Calliandra emarginata* (H. & B.) Benth. San Clemente-Dos Arroyos road, Bartlett 12818. A shrub 3 meters high, growing in climax forest.

*Calliandra* sp. Chultejillo. San Benito, Aguilar 26. A slender shrub, growing in secondary upland forest.

*Canavalia villosa* Benth. El Paso, Lundell 1451. A slender vine, growing in low secondary bush.

*Cassia anisopetala* Donn. Sm. Kanchinaik. Ixpop, Cook & Martin 193. A shrub or small tree.

*Cassia bacillaris* L. f. Santa Cruz, Bartlett 12404. A shrub 3 meters high; collected in secondary upland forest.

*Cassia grandis* L. f. Bukut, Cañafistula. Tikal, Bartlett 12641. A tree 60 cm. in diameter and reaching a height of 18 meters; common around aguadas in villages and ruins. I have not encountered this species growing wild in the forest except on the sites of old Maya cities.

*Cassia petensis* (Britt. & Rose) Standl. Campo Aviacion, Lake Petén, Lundell 4393. A subsucculent thorny shrub, growing in secondary upland forest.

*Cassia spectabilis* DC. Remate, Lundell 2075. A small tree, growing in secondary upland forest.

*Centrosema plumieri* (Turp.) Benth. Zapatito de reina. Santa Cruz, Bartlett 12383. A slender vine, collected in secondary upland forest.

*Centrosema virginianum* (L.) Benth. Remate, Lundell 2076. A small herbaceous vine; common in secondary upland forest.

*Dalbergia glabra* (Mill.) Standl. Ixcipix. Uaxactun, Bartlett 12429. A large liana as much as 15 cm. in diameter; collected in climax forest. Strips of the tough flexible bark are used extensively as cordage.

*Desmanthus virgatus* (L.) Willd. El Paso, Lundell 1503; Campo Aviacion, Lake Petén, Lundell 3223. A small subshrub not exceeding 1 meter in height; occasional in fields and inhabited clearings.

*Desmodium frutescens* (Jacq.) Schindl. Mozote. El Paso, Lundell 1561; Campo Aviacion, Lake Petén, Lundell 4392; Uaxactun, Bartlett 12561. A slender perennial; common in inhabited clearings and recently abandoned clearings.

*Diphysa carthagenensis* Jacq. Zuzul. Nictun, Lundell 3140. A shrub or small tree; collected along the shore of Lake Petén in an area which was being periodically flooded owing to the rising water-level.

*Gliricidia sepium* (Jacq.) Steud. Without locality, Cook & Martin 233. A small tree.

*Hæmatoxyllum brasiletto* Karst. A low gnarled tree; common in the central areas of swamp forest (*tintal*).

*Hæmatoxyllum campechianum* L. *Palo tinta*, *Tinta*. El Paso, *Lundell* 1566; Uaxactun, *Bartlett* 12698; without locality, *Cook & Martin* 210. A tree with fluted trunk and shreddy bark reaching a diameter of 60 cm. and a height of 8 meters; very common in the central areas of swamp forest. The hæmatoxylin of commerce is obtained from its reddish-brown heartwood. This species and the former characterize the *tintal* association.

*Indigofera suffruticosa* Mill. El Paso, *Lundell* 1542. A shrub about 2 meters high; common in recently abandoned clearings.

*Inga edulis* Mart. El Paso, *Lundell* 1505. A slender tree not exceeding 10 meters in height; common on low wet river banks. The white pulp surrounding the seed is edible.

*Inga spuria* Humb. & Bonpl. (?). *Abitz*. Tikal, *Bartlett* 12650. A small tree, growing in the *aguada* at Tikal.

*Lennea robinoides* Klotzsch. Uaxactun, *Bartlett* 12224; Yaloch, *Bartlett* 12855. A shrub 3 meters high; collected in secondary upland forest and on the dry sandy bed of Arroyo Uaxactun.

*Lonchocarpus castilloi* Standl. *Manchich*. Uaxactun, *Bartlett* 12215. A large tree, growing in climax forest.

*Lonchocarpus guatemalensis* Benth. *Ixec subin*, *Habin*. Uaxactun, *Bartlett* 12413, 12506, 12571, 12573, 12772; Tikal, *Bartlett* 12654. A tree reaching a diameter of 75 cm.; common in swamp forest, occasional in climax forest.

It is probable that more than one species is represented by the collections.

*Lonchocarpus hondurensis* Benth. *Ixtzente*, *Ciicche*. El Paso, *Lundell* 1470, 1479, 1521, 1612; Arroyo Kantetul, *Lundell* 3163; Uaxactun, *Bartlett* 12239, 12454; San Clemente-Dos Arroyos road, *Bartlett* 12823. Generally a small tree, but sometimes reaching a diameter of from 60 to 90 cm.: common on low wet river banks and in swamp forest (*escobal*).

*Lysiloma bahamensis* Benth. *Tzalam*. Lake Yaxha, *Lundell* 2149; San Andres, *Lundell* 3184. A tree reaching a diameter of 40 cm. and a height of 15 meters; very common on lake banks. The species can not endure flooding, for the lake shores are lined with dead individuals where the water-level has risen.

*Lysiloma desmostachys* Benth. *Zupte*. Kantetul, *Lundell* 3172. A small gnarled tree about 5 meters high; occasional in Sabana Kantetul.

*Mimosa hemiendyta* Rose & Robins. Dos Arroyos, *Bartlett* 12109. A small wiry tree 10 to 15 cm. in diameter; common in swamp forest (*tintal*).

*Mimosa pigra* L. *Zarza*. Lake Yaxha, *Lundell* 2148; Campo Aviacion, Lake Petén, *Lundell* 3114; without locality, *Cook & Martin* 188. A shrub 1 to 3 meters high; collected in secondary forest.

*Mimosa pseudopaniculata* Britton. El Paso, *Lundell* 1450. A thorny liana, growing in low secondary upland bush.

*Pachyrrhizus erosus* (L.) Urban. *Caxilchicam*. Santa Cruz, *Bartlett* 12407. A coarse vine, growing in secondary upland bush.

*Pachyrrhizus palmatilobus* (Moc. & Sessé) Benth. & Hook. *Chicamilcaax*. Uaxactun-San Clemente road, *Bartlett* 12799. A coarse vine; collected in climax forest.

*Phaseolus atropurpureus* DC. *Uaco*. Nictun, *Lundell* 3151. A small herbaceous vine, growing on the low periodically flooded banks of Lake Petén.

*Phaseolus speciosus* HBK. (?). Tikal, *Bartlett* 12591. A large tough vine.

*Phaseolus vulgaris* L. *Frijol*. Cultivated extensively. Beans rank next to maize in importance as a staple food.

*Piscidia communis* (Blake) Harms. *Habin*. Without locality, *Cook & Martin* 218. A tree generally not exceeding 8 meters in height.

*Pithecolobium englesingii* Standl. Uaxactun, *Bartlett* 12569. A tree 30 cm. in diameter; occasional in climax forest.

*Pithecolobium erythrocarpum* Standl. San Clemente-Dos Arroyos road, *Bartlett* 12830. A slender shrub or small tree, growing in climax forest.

*Pithecolobium lanceolatum* (Humb. & Bonpl.) Benth. El Paso, *Lundell* 1610; San Benito, *Aguilar* 21; Uaxactun-San Clemente road, *Bartlett* 12790. A shrub or small tree; collected in the central area (*tintal*) of a wooded swamp and in secondary upland forest. Aguilar reports that the fruits are acid and edible.

*Pithecolobium latifolium* (L.) Benth. El Paso, *Lundell* 1497. A medium-sized tree, growing on low river banks.

*Pithecolobium macrandrium* Donn. Sm. *Motilla*. San Benito, *Aguilar* 3. A tree, growing in secondary upland forest.

*Pithecolobium pachypus* Pittier. *Tucuy*. Remate, *Lundell* 2090, 3242; San Andres, *Lundell* 3182; Campo Aviacion, Lake Petén, *Lundell* 3243; Santa Cruz, *Bartlett* 12364. A shrub or small tree, thorny; common in inhabited clearings and recently abandoned clearings.

*Pithecolobium platylobum* (Spreng.) Urb. (?). San Andres, *Lundell* 3116. A large woody vine, growing on the bank along the north shore of Lake Petén.

*Rhynchosia longeracemosa* Mart. & Gal. *Ixbeho*. Kantetul, *Lundell* 3166. A small herbaceous vine, growing in Sabana Kantetul.

*Rhynchosia minima* (L.) DC. El Paso, *Lundell* 1569. A small herbaceous vine; collected in secondary upland bush.

*Swartzia lundellii* Standl. *Cataox*, *Lloro sangre*. Sabana Zis, *Lundell* 3189. A tree 45 cm. in diameter and 12 meters high with large spreading crown. When the cortex is cut, a reddish fluid exudes, whence the name *lloro sangre*. The tree grows commonly on the limestone hills in the Central Petén Savanna Country, but in Northern Petén it was encountered only in Sabana Zis.

*Vigna repens* (L.) Kuntze. El Paso, *Lundell* 1519; Lake Zotz, *Lundell* 3299. A slender vine; common on wet lake and river banks.

#### ZYGOPHYLLACEÆ

*Kallstræmia maxima* (L.) Torr. & Gray. Flores, *Lundell* 4205. A prostrate annual; common weed of inhabited clearings.

#### RUTACEÆ

*Amyris sylvatica* Jacq. *Ciinche*. Tikal, *Bartlett* 12608; Uaxactun, *Bartlett* 12667; Uaxactun-San Clemente road, *Bartlett* 12803. A small slender tree; collected in climax forest and secondary upland forest.

*Citrus aurantifolia* (Christm.) Swingle. *Limon*. A small tree; cultivated for its fruits.

*Citrus aurantium* L. *Naranja agria*. A small tree; cultivated for its fruits.

*Citrus sinensis* Osbeck. *Naranja de China*. A small tree; cultivated for its fruits.

*Murraya paniculata* (L.) Jack. San Andres. A shrub or small tree; commonly planted for ornament.

*Zanthoxylum caribæum* Lam. *Sinanche*. Without locality, *Cook & Martin* 217. A tree sometimes reaching a height of 15 meters; occasional in climax forest.

#### MELIACEÆ

*Cedrela mexicana* Roem. *Cedro*. Uaxactun, *Bartlett* 12171, 12568. A large tree sometimes reaching a diameter of more than 1 meter; widely distributed through the climax forest; common in some areas.

*Guarea excelsa* HBK. *Cedrillo*. Uaxactun, *Bartlett* 12141, 12210, 12321, 12703. A small slender tree; common in climax forest, occasional in swamp forest.

*Swietenia macrophylla* King. *Caoba*. Uaxactun, *Bartlett* 12173, 12673. A giant tree reaching a diameter of about 3 meters and a height of 70 meters; widely distributed throughout the climax forest. Stunted individuals of the species are often encountered in swamp forest (*botanal*). The wood is the common mahogany of commerce. The stands of the tree in Northern Petén have hardly been touched, hence this region remains as one of the most extensive reserves for future exploitation. The gum obtained from the trunk is employed by Indians for various medicinal purposes; their cuts to obtain this gum are responsible for the death of many valuable trees.

*Trichilia havanensis* Jacq. *Limoncillo*. Macanche, on Yaxha-Remate road, *Lundell* 3950; Tikal, *Bartlett* 12625. A tree reaching a height of 10 meters; occasional in climax forest.

*Trichilia minutiflora* Standl. *Chaltecoc*. Yaxha-Remate road, *Lundell* 3949, 3951; Uaxactun, *Cook & Martin* 95; *Bartlett* 12197, 12282, 12285, 12420, 12467. A tree 15 to 25 cm. in diameter and reaching a height of 10 meters; common in climax forest.

*Trichilia montana* HBK. El Paso, *Lundell* 1459. A small tree; collected in secondary upland forest.

*Trichilia moschata* Sw. *Chacchaltecoc*, *Copal colorado*. Uaxactun, *Bartlett* 12412, 12445, 12775. A tree 30 cm. in diameter and 12 meters high; common in climax forest, occasional in swamp forest (*escobal*).

#### SIMARUBACEÆ

*Alvaradoa amorphoides* Liebm. *Besinicche*. Macanche, *Lundell* 4391; without locality, *Cook & Martin* 208. A slender tree 4 to 8 meters high; quite common in secondary upland forest.

*Simaruba glauca* DC. Pazac, Pasaak, Negrito. Uaxactun, Bartlett 12662; without locality, Cook & Martin 75. A tree 20 to 60 cm. in diameter and reaching a height of 25 meters; occasional in climax forest.

## BURSERACEÆ

*Bursera simaruba* (L.) Sarg. Chacah, Chic-chica, Chicah. San Andres, Lundell 3118; Uaxactun, Bartlett 12668, 12764. Although usually a medium-sized tree, some individuals in the high climax forest reach a diameter of 75 cm. and a height of 30 meters. The species is very common in climax forest and secondary upland forest.

*Protium copal* (Schl. & Cham.) Engl. Copal. Uaxactun, Bartlett 12143, 12469. A small tree not exceeding 30 cm. in diameter; occasional in climax forest.

## MALPIGHIACEÆ

*Byrsonima crassifolia* (L.) HBK. Nanze. A small gnarled tree scarcely ever exceeding 5 meters in height; common in savannas.

*Hirza obovata* (HBK.) Ndzu. Utop-chocak. Uaxactun, Bartlett 12696, 12709, 12782. A large woody vine; common in swamp forest.

*Malpighia glabra* L. Sibche. El Paso, Lundell 1585; without locality, Cook & Martin 136. A shrub or small tree not exceeding 6 meters in height; generally common in secondary upland forest.

*Mascagnia malpighiodes* (Turz.) Morton. Aguada Tigre, on Yaxha-Remate road, Lundell 2078. A slender woody vine; occasional in climax forest.

*Mascagnia polycarpa* T. S. Brandeg. El Paso, Lundell 1520. A slender woody vine; occasional in secondary upland forest.

*Stigmaphyllon ellipticum* (HBK.) A. Juss. San Andres, Lundell 3128. A small suffrutescent or woody vine; occasional on the banks along the north shore of Lake Petén.

*Tetrapteris seleriana* Ndzu. Zuac. Tikal, Bartlett 12632. A large woody vine; generally encountered in secondary upland forest.

## POLYGALACEÆ

*Polygala jamaicensis* Chodat. Limonaria cimarron. Sabana Zis, Lundell 3187. A small shrub about 3 meters high, growing in marginal scrub forest on outcropping limestone.

## EUPHORBIACEÆ

*Acalypha diversifolia* Jacq. (?). Cicche, Palo de sangre. Uaxactun, Bartlett 12217. A tree 20 cm. in diameter; occasional in climax forest.

*Acalypha flagellata* Millsp. El Paso, Lundell 1493. A large shrub; common in secondary upland bush.

*Acalypha setosa* A. Rich. Corrimiento. El Paso, Lundell 1511. A small erect annual; common in clearings in moist places.

*Acalypha unibracteata* Muell. Arg. La Libertad-Flores road, Lundell 4121. A large shrub; collected in secondary upland forest.

*Acalypha villosa* Jacq. San Andres, Lundell 3198; Uaxactun, Bartlett 12151; San Clemente-Dos Arroyos road, Bartlett 12833. A large shrub or small tree; collected along the bank of Lake Petén, on the dry sandy bed of Arroyo Uaxactun, and in climax forest on a hill.

*Acalypha* sp. Yaxha-Remate road, Lundell 4095. A shrub, growing along the road in shade of climax forest.

*Adelia barbinervis* Schl. & Cham. El Paso, Lundell 1478. A small spiny tree, growing in secondary upland forest.

*Astrocasia phyllanthoides* Robins. & Millsp. Chin-chin. Uaxactun, Bartlett 12528. A small tree about 10 cm. in diameter; collected on a hill in climax forest.

*Bernardia interrupta* (Schl.) Muell. Arg. Uaxactun, Bartlett 12293; Uaxactun-San Clemente road, Bartlett 12806. A small tree 3 to 5 meters high; occasional in swamp forest (tintal) and secondary forest of the uplands.

*Codiaeum variegatum* (L.) Blume. Flores, Lundell 4258. A shrub; cultivated for ornament.

*Croton glabellus* L. Perescuch. Reported by Standley in his *Flora of Yucatan* as having been collected in Petén by Cook and Martin. The species is a shrub or small tree.

*Croton macrodontus* Muell. Arg. (?). Aguada Tigre-Yaxha road, Lundell 4128. A tree 8 meters high, growing in secondary upland forest.

*Croton niveus* Jacq. *Zicche*. Fallabon-Yaxha road, *Lundell 2153*; Aguada Tigre-Yaxha road, *Lundell 4127*; Santa Cruz, *Bartlett 12409*; Uaxactun-San Clemente road, *Bartlett 12793*. A tree 3 to 10 meters high; common in secondary upland forest, occasional in swamp forest.

*Croton reflexifolius* HBK. *Palito de sabana*. La Libertad-Flores road, *Lundell 4122*; Dos Arroyos, *Bartlett 12103*; Uaxactun, *Bartlett 12697*. A small tree 3 to 6 meters high; common in swamp forest (*tintal*), occasional in secondary upland forest.

*Dalechampia dioscoreæfolia* Poepp. & Endl. (?). *Moolcoh*. Without locality, *Cook & Martin 203*.

*Drypetes brownii* Standl. *Bulhop*. Dos Arroyos-Yaloch road, *Bartlett 12846*; Yaloch-El Cayo road, *Bartlett 12865*. A small tree 20 cm. in diameter; common in climax forest.

*Drypetes lateriflora* (Sw.) Krug. & Urb. Uaxactun, *Bartlett 12358*. A small tree 20 cm. in diameter; occasional in climax forest.

*Euphorbia armourii* Millsp. El Paso, *Lundell 1482*. A small erect annual, growing in clearings.

*Euphorbia brasiliensis* Lam. La Libertad-Flores road, *Lundell 4120*. An annual, growing in clearings.

*Euphorbia graminea* Jacq. *Escorpion xil*. Uaxactun, *Bartlett 12212, 12267*; without locality, *Cook & Martin 155*. A small herb; common in inhabited clearings. It was also collected on the dry sandy bed of Arroyo Uaxactun.

*Euphorbia heterophylla* L. La Libertad-Flores road, *Aguilar 24*. A small annual, growing in clearings.

*Euphorbia hirta* L. Tayasal, *Lundell 4125*. An annual, growing in clearings.

*Euphorbia hypericifolia* L. El Paso, *Lundell 1514*. An erect annual; common in inhabited clearings.

*Euphorbia lancifolia* Schl. (?). *Ixbut*. Without locality, *Cook & Martin 222*.

*Euphorbia lasiocarpa* Klotzsch. Tayasal, *Lundell 4124*. An annual, growing in clearings.

*Euphorbia thymifolia* L. Flores, *Lundell 4259*. A small herb; very common throughout the city, growing between the cobblestones.

*Gymnanthes lucida* Sw. Aguada Tigre-Yaxha road, *Lundell 4129*. A small tree 10 meters high, growing in secondary upland forest.

*Jatropha hastata* Jacq. El Paso, *Lundell 1597*. A shrub; cultivated for ornament.

*Jatropha tubulosa* Muell. Arg. San Andres, *Lundell 3131*. A coarse erect subshrub 1 to 3 meters high; occasional in secondary upland forest.

*Pedilanthus tizæus* Millsp. Without locality, *Cook & Martin 139*. A slender shrub.

*Pedilanthus tithymaloides* Poit. *Pie de niño, Pie de santo*. San Andres, *Lundell 3144*; Uaxactun, *Bartlett 12194*. A slender shrub 1 to 2 meters high, growing in climax forest and secondary upland forest.

*Phyllanthus carolinensis* Walt. La Libertad-Flores road, *Lundell 4123*. A small erect herb, growing in clearings.

*Phyllanthus conami* Sw. San Benito, *Aguilar 22*. A shrub or small tree; common in secondary upland forest.

*Phyllanthus ferox* Standl. Yaxha-Remate road, *Lundell 4126*; Uaxactun, *Bartlett 12157*, type collection. A small erect subshrub; collected in road clearings and on the dry sandy bed of Arroyo Uaxactun.

*Phyllanthus micrandrus* Muell. Arg. El Paso, *Lundell 1458*. A small tree; collected in secondary upland forest.

*Phyllanthus nobilis* (L. f.) Muell. Arg. Campo Aviacion, *Lundell 3136*; La Libertad-Flores road, *Lundell 4338*. A shrub or small tree; common in secondary upland forest.

*Ricinus communis* L. Santa Cruz, *Bartlett 12377*. An erect suffrutescent herb or shrub; common in recently abandoned clearings.

*Sapium jamaicense* Sw. Fallabon-Yaxha road, *Lundell 2192*. A small tree about 8 meters high; collected in climax forest.

*Sebastiania adenophora* Pax & Hoffm. El Paso, *Lundell 1607*. A small tree; occasional in secondary upland forest, and probably present in climax forest.

*Sebastiania longicuspis* Standl. *Icicheh, Chechem blanco*. Yaxmoxan, on Remate-Yaxha road, *Lundell 4304*; Uaxactun, *Bartlett 12152, 12731*. A tree 30 cm. in diameter and 15 meters high; common in climax forest.

#### ANACARDIACEÆ

*Anacardium occidentale* L. *Marañon*. El Paso, *Lundell 1504*. A small tree; cultivated for its fruits.



*Mangifera indica* L. *Mango*. A medium-sized tree; cultivated quite extensively for its fruits.

*Metopium brownei* (Jacq.) Urban. *Chechem*. Remate, *Lundell 2080*; Uaxactun, *Bartlett 12695*; without locality, *Cook & Martin 223*. A tree which varies greatly in size, depending on the habitat; in climax forest it is sometimes 25 meters high and 60 to 90 cm. in diameter. It is one of the most widely distributed species in the region, being common in upland and swampy habitats.

*Spondias mombin* L. A tree reaching a height of 25 meters; very common in climax forest and secondary upland forest.

*Spondias purpurea* L. A small gnarled tree; cultivated for its plum-like fruits.

#### HIPPOCRATEACEÆ

*Hippocratea celastroides* HBK. Uaxactun, *Bartlett 12770*.

*Hippocratea subintegra* Blake. *Zackuche*. Sabana Zis, *Lundell 3193*. A small tree with compact lustrous crown; occasional in savannas.

*Hippocratea volubilis* L. Uaxactun-San Clemente road, *Bartlett 12789*. In logwood swamp (*tintal*).

#### CELASTRACEÆ

*Rhacoma gaumeri* (Loes.) Standl. Uaxactun, *Bartlett 12418*.

*Rhacoma riparia* Lundell. San Pedro de Martir River, *Lundell 1476*. A slender shrub or treelet; collected on the swampy banks of the river.

*Wimmeria concolor* Schl. & Cham. *Chintoc*, *Ixolte-ixnuc*, *Quiebra hacha blanco*. Uaxactun, *Bartlett 12216*, *12435*, *12481*, *12536*, *12773*. A medium-sized tree sometimes 70 cm. in diameter; apparently quite common in climax forest.

#### SAPINDACEÆ

*Cardiospermum grandiflorum* Sw. El Paso, *Lundell 1583*. A slender suffrutescent vine, growing in secondary upland forest.

*Cupania belizensis* Standl. *Copal colorado*. Uaxactun, *Bartlett 12457*, *12765*. A small tree 10 to 25 cm. in diameter; occasional in swamp forest (*escobal*) and climax forest.

*Cupania prisca* Standl. *Tzol*. Uaxactun, *Bartlett 12341*, type collection. A tree 25 cm. in diameter, growing in climax forest.

*Exothea paniculata* (Juss.) Radlk. *Pimientillo*. Uaxactun, *Bartlett 12560*. A medium-sized tree 30 cm. in diameter; occasional in climax forest.

*Paullinia fuscescens* HBK. Uaxactun, *Bartlett 12458*. A woody vine; occasional in swamp forest (*escobal*).

*Paullinia pinnata* L. *Salatxiu*. Without locality, *Cook & Martin 76*. A woody vine; generally common in secondary upland forest.

*Paullinia tomentosa* Jacq. Uaxactun, *Bartlett 12465*. A woody vine; occasional in secondary upland forest.

*Sapindus saponaria* L. *Jaboncillo*. Uaxactun, *Bartlett 12195*. A tree about 60 cm. in diameter; occasional in climax forest.

*Serjania adiantoides* Radlk. Dos Arroyos, *Bartlett 12102*. A slender woody vine; occasional in swamp forest (*tintal*).

*Serjania cardiospermoides* Schl. & Cham. *Zicac*. Remate, *Lundell 2019*; Uaxactun, *Bartlett 12228*. A slender woody vine; occasional in climax forest and secondary upland forest.

*Serjania mexicana* (L.) Willd. El Paso, *Lundell 1446*; Tikal, *Bartlett 12609*. A woody vine; common in secondary upland forest.

*Serjania pterarthra* Standl. El Paso, *Lundell 1531*. A suffrutescent vine; occasional in secondary upland forest. It appears to prefer wet soils.

*Serjania scatens* Radlk. Dos Arroyos, *Bartlett 12104*; Santa Cruz, *Bartlett 12394*, *12406*; Dos Arroyos-Yaloch road, *Bartlett 12843*. A slender woody vine; common in swamp forest (*tintal*, *escobal*) and in secondary upland forest.

*Talisia floresii* Standl. *Poloc*, *Ixeczul*. San Andres, *Lundell 3121*; Kantetul-San Andres road, *Lundell 3185*; El Paso, *Lundell 1480*; Uaxactun, *Bartlett 12661*, *12680*. A large tree reaching a diameter of 60 cm. and a height of 18 meters; common in swamp, lake bank, climax, and secondary upland forest. This is one of the few large trees growing in logwood swamps.

*Talisia olivæformis* (HBK.) Radlk. *Uayum, Guayo*. Topoxte. A tree reaching a height of 20 meters; occasional in climax forest. The species is planted commonly in villages for its excellently flavored plum-like fruits. On the ruins of Topoxte grow several tall trees, possibly relics from ancient times.

*Thouinia paucidentata* Radlk. Uaxactun, Bartlett 12414. A small tree about 8 meters high; occasional in climax forest.

The tree which I reported as *Allophylus jejunus* Standl. (Lundell, 1934b) is *T. paucidentata*. *A. jejunus* is a *nomen nudum*.

*Urvillea ulmacea* HBK. Remate, Lundell 2031; El Paso, Lundell 1550. A slender woody vine; common in secondary upland forest.

#### RHAMNACEÆ

*Krugiodendron ferreum* (Vahl) Urban. *Quiebra hacha*. Uaxactun, Bartlett 12421. A medium-sized tree 45 cm. in diameter; occasional in climax forest.

#### VITACEÆ

*Cissus sicyoides* L. *Sanaltodo*. El Paso, Lundell 1494; without locality, Cook & Martin 77. A slender woody vine; common in secondary upland forest.

*Vitis tiliæfolia* Humb. & Bonpl. *Bejuco de agua*. Laguna Perdida, Lundell 1642; Uaxactun, Bartlett 12332, 12427. A large liana; occasional in climax forest and secondary upland forest. The fruits are small and very acid.

#### TILIACEÆ

*Corchorus siliquosus* L. Uaxactun, Bartlett 12231. A shrub 1 to 1.5 meters high; common in inhabited clearings.

*Muntingia calabura* L. *Capolin blanco*. El Paso, Lundell 1452; San Andres, Lundell 3142; Santa Cruz, Bartlett 12372. A small tree 4 to 8 meters high; occasional in secondary upland forest.

*Triumfetta semitriloba* Jacq. El Paso, Lundell 1551. A shrub 1 to 2 meters high; common in inhabited clearings and recently abandoned clearings.

#### MALVACEÆ

*Abutilon lignosum* (Cav.) Don. El Paso, Lundell 1540. A shrub 1 to 2 meters high; occasional in inhabited clearings and recently abandoned clearings.

*Gossypium barbadense* L. *Algodon*. Cultivated to a very limited extent in yards.

*Hibiscus clypeatus* L. Uaxactun, Bartlett 12462. A shrub 3 to 4 meters high; occasional in low secondary bush (*guamil*).

*Hibiscus mutabilis* L. El Paso, Lundell 1559. A large shrub; cultivated for ornament.

*Hibiscus rosa-sinensis* L. A large shrub; cultivated for ornament.

*Hibiscus schizopetalus* (Mart.) Hook. A large shrub; cultivated for ornament.

*Hibiscus sororius* L. f. Uaxactun, Bartlett 12291. A shrub 1 to 2 meters high; occasional in secondary upland bush.

*Malachra alceifolia* Jacq. *Yerba sapo*. Uaxactun, Bartlett 12347, 12737. A coarse herb; common in inhabited clearings and recently abandoned clearings.

*Malachra capitata* L. El Paso, Lundell 1536. A coarse herb; common in inhabited clearings and recently abandoned clearings. Both this and the preceding species prefer wet soils.

*Malvastrum coromandelianum* (L.) Garcke. *Chichibe*. El Paso, Lundell 1589; Uaxactun, Bartlett 12348. A weedy herb; common in inhabited clearings.

*Malvaviscus arboreus* Cav. *Tamanchich, Tulipancillo*. Uaxactun, Bartlett 12178; without locality, Cook & Martin 63, 197. A shrub; occasional in low secondary bush.

*Sida acuta* Burm. *Chichibe*. Uaxactun, Bartlett 12579. A weedy herb; common in inhabited clearings and recently abandoned clearings.

*Sida glutinosa* Commers. Uaxactun, Bartlett 12122, 12319. A weedy herb; common in inhabited clearings and recently abandoned clearings.

#### BOMBACACEÆ

*Bernoullia flammea* Oliver. *Uacut*. Tikal, Bartlett 12629. A large tree, growing in the forest covering the ruins of Tikal.

*Bombax ellipticum* HBK. *Mapola*. Without locality, Cook & Martin 114. A large tree; occasional in climax forest.

*Ceiba pentandra* (L.) Gaertn. Uaxactun, Bartlett 12432. A giant tree 1 meter in diameter with spiny trunk; widely distributed through climax forest.

*Hampea trilobata* Standl. Not collected in Northern Petén, but undoubtedly present in the region.

*Pachira aquatica* Aubl. Zapotobobo. A small tree not exceeding 10 meters in height; common on lake and stream banks in swampy places. According to local reports, it also grows around aguadas in some bajos.

*Quararibea fieldii* Millsp. Huyu. Uaxactun, Bartlett 12220. A medium-sized tree with verticillate branches; occasional in climax forest.

## STERCULIACEÆ

*Byttneria aculeata* Jacq. El Paso, Lundell 1526. A spiny scandent or clambering shrub; common in low secondary bush in wet places.

*Byttneria catalpifolia* Jacq. El Paso, Lundell 1495. A woody scrambler, growing in secondary upland bush.

*Guazuma ulmifolia* Lam. Pixoy. El Paso, Lundell 1515; Uaxactun, Bartlett 12771; Yaloch, Bartlett 12858. Generally a small tree about 8 meters high, but occasionally larger; very common in secondary upland forest, pastures, and around villages.

*Helicteres guazumæfolia* HBK. San Benito, Lundell 1657. A large shrub 2 to 5 meters high; very common in secondary upland forest.

*Theobroma cacao* L. Cacao. A small tree; cultivated to a limited extent.

*Waltheria americana* L. Dos Arroyos, Bartlett 12114. A shrub 2 meters high, growing in swamp forest (*tintal*).

## DILLENIACEÆ

*Curatella americana* L. Saha. A small gnarled shaggy-barked tree not exceeding 6 meters in height; common in all savanna areas.

*Tetracera volubilis* L. Uaxactun, Bartlett 12242. A woody vine; occasional in climax forest and swamp forest.

## OCHNACEÆ

*Ouratea jurgensenii* (Planch.) Engl. Ixpambul. Uaxactun, Bartlett 12240; San Pedro de Martir River, Lundell 1473. A shrub or small slender tree; occasional in swampy areas such as low river banks.

Standley considers these collections as representing *O. stenobotrys* Riley.

*Ouratea* sp. Utop-chililche. Tikal, Bartlett 12631; Yaloch-El Cayo road, Bartlett 12867; San Pedro de Martir River, Lundell 1477. A small tree about 15 cm. in diameter, growing in the forest covering the ruins of Tikal, in climax forest and on swampy river banks.

## TERNSTROMIACEÆ

*Ternstroemia sphærocarpa* (Rose) Melch. Uxihl-il-caax. Uaxactun-San Clemente road, Bartlett 12802. A small tree 15 cm. in diameter.

*Ternstroemia tepezapote* Schl. & Cham. Chique. Sabana Zis, Lundell 3204. A small erect tree 4 to 8 meters high; occasional in savannas.

## CLUSIACEÆ

*Calophyllum brasiliense* Camb. var. *rekoi* Standl. Santa Maria. A giant tree, reaching a diameter of 1 meter and an estimated height of 40 meters; common in climax forest along the northeastern boundary, probably widely distributed throughout Northern Petén.

*Clusia flava* Jacq. Hubuche. Sabana Zis, Lundell 3238. A tree 8 meters high, growing in marginal forest.

*Clusia* sp. Dos Arroyos, Bartlett 12118. A tall tree, growing in swamp forest (*tintal*).

Several additional species of *Clusia* are represented by Bartlett's collections from northeastern Petén.

## VIOLACEÆ

*Hybanthus angustifolius* (HBK.) Standl. La Libertad-Flores road, Lundell 4225. A slender herb, growing in clearings.

*Hybanthus longipes* (Dowell) Standl. Yaxmoxan, on Yaxha-Remate road, *Lundell 4254*. A small perennial, growing along the road, in the shade of climax forest.

*Hybanthus yucatanensis* Millsp. Ixlu, *Lundell 4307*; Uaxactun, *Bartlett 12135, 12137, 12311*. A shrub 2 to 3 meters high; occasional in climax forest and secondary upland forest.

*Hybanthus* sp. *Can muholaal*. Without locality, *Cook & Martin 198*. Probably one of the above species.

#### FLACOURTIACEÆ

*Hasseltia dioica* (Benth.) Sleumer. A shrub or small tree; reported by Bartlett as growing in swamp forest.

*Lætia thamnina* L. *Ixbakelak*, *Bakelak*, *Hueso de tortuga*. Fallabon-Yaxha road, *Lundell 3952*; Uaxactun, *Bartlett 12707*; Dos Arroyos-Yaloch road, *Bartlett 12847*. A small tree, sometimes reaching a height of 8 meters; common in secondary upland forest, occasional in climax forest.

*Prockia crucis* L. *Mozote*. La Libertad-Flores road, *Lundell 4340*. A shrub or small slender tree; common in secondary upland forest.

*Xylosma characantha* Standl. Uaxactun, *Bartlett 12334*. A shrub 1 meter high; collected in climax forest.

*Xylosma flexuosa* (HBK.) Hemsl. Uaxactun, *Bartlett 12352*. A shrub 2 meters high, growing at edge of the *aguada* at Uaxactun.

*Xylosma hemsleyana* Standl. *Nuum-tsu-tswi*. Yaxmoxan, *Cook & Martin 195*. A shrub or small tree.

*Zuelania guidonia* (Sw.) Britt. & Millsp. *Tamay*. Uaxactun, *Bartlett 12552*. A medium-sized tree 45 cm. in diameter; occasional in climax forest.

#### CARICACEÆ

*Carica papaya* L. *Papayo*. Uaxactun, *Bartlett 12758*; without locality, *Cook & Martin 153*. Erect plants 1 to 2.5 meters high; common in *milpas* and recently abandoned inhabited clearings. The species is cultivated around Lake Petén for its excellent fruits.

#### PASSIFLORACEÆ

*Passiflora adenopoda* DC. Uaxactun, *Bartlett 12130*; without locality, *Cook & Martin 142*. An herbaceous vine, growing in low secondary bush (*guamil*).

*Passiflora biflora* Lam. *Xicxotz*, *Ala de murcielago*. El Paso, *Lundell 1490*; Flores, *Aguilar 165*; Uaxactun, *Bartlett 12360, 12510*. A slender suffrutescent vine; common in climax forest and secondary upland forest, occasional in swamp forest (*botanal*).

*Passiflora coriacea* Juss. *Xicxotz*. Uaxactun, *Bartlett 12270, 12755*; without locality, *Cook & Martin 196*. A slender vine; occasional in climax forest and secondary upland forest.

*Passiflora fœtida lanuginosa* Killip. Nictun, *Lundell 3125*. A slender herbaceous vine, growing on the low periodically flooded bank of Lake Petén.

*Passiflora fœtida ciliata* (Dryand.) Mast. San Clemente-Dos Arroyos road, *Bartlett 12832*. A large herbaceous vine, growing in open climax hill forest.

*Passiflora hahnii* (Fourn.) Mast. Yaxha-Remate road, *Lundell 2015*; without locality, *Cook & Martin 67*. A slender vine, growing in the shade of climax forest.

*Passiflora palmeri sub lanceolata* Killip. Uaxactun-San Clemente road, *Bartlett 12788*. A suffrutescent vine; collected in swamp forest (*tintal*).

*Passiflora prolata* Mast. Dos Arroyos-Yaloch road, *Bartlett 12840*. A slender vine; collected in swamp forest (*escobal*).

*Passiflora rovirosæ* Killip. *Xicxotz*, *Ala de murcielago*. Uaxactun, *Bartlett 12691*. A slender vine, growing in secondary upland forest.

*Passiflora suberosa* L. Campo Aviacion, Lake Petén, *Lundell 3844*. A slender vine; occasional in secondary forest.

#### BEGONIACEÆ

*Begonia glabra* Aubl. Fallabon-Yaxha road, *Lundell 2016*. A small scandent epiphyte; collected on a tree trunk in climax forest.

*Begonia nicaraguensis* Standl. Tikal, *Bartlett 12582*.

*Begonia towarensis* Klotzsch. Lake Zotz, *Lundell 3291*. An herb, growing in the fern and sedge bog of Lake Zotz.

## CACTACEÆ

*Cereus grandiflorus* (L.) Mill. San Andres, *Lundell 3234*. A large vine, forming masses on trees; common in older forest and around villages.

*Cereus undatus* Haw. *Pitahaya*. San Jose, *Lundell 3235*. A large vine, forming masses on trees; occasional around villages. The fruit is said to be edible.

*Rhipsalis cassutha* Gært. *Tatache*. Without locality, *Cook & Martin 133*.

*Rhipsalis* sp. Uaxactun, *Bartlett 12720*. Collected on trees growing at the edge of the *aguada* at Uaxactun.

## LYTHRACEÆ

*Lawsonia inermis* L. San Andres, *Lundell 3178*. A small tree; apparently planted for ornament.

## COMBRETACEÆ

*Bucida buceras* L. *Pucte*, *Pocte*. Dos Arroyos, *Bartlett 12116*; Uaxactun, *Bartlett 12349*; San Clemente-Dos Arroyos road, *Bartlett 12825*; without locality, *Cook & Martin 144, 187*. A large tree 40 to 90 cm. in diameter and reaching a height of 30 meters; common on wet *aguada*, lake, and stream banks, often one of the dominant species; occasional in logwood swamps.

*Combretum farinosum* HBK. El Paso, *Lundell 1529*; Santa Cruz, *Bartlett 12374*; Uaxactun, *Bartlett 12424*. A large woody scrambler sometimes 10 cm. in diameter; common in secondary upland forest, occasional in swamp forest.

*Terminalia excelsa* Liebm. *Kanxan*. Yaloch-El Cayo road, *Bartlett 12870*. A tree sometimes 30 meters high; occasional in climax forest. Probably a synonym of the next species.

*Terminalia obovata* (R. & P.) Steud. *Kanxan*. Uaxactun-San Clemente road, *Bartlett 12792*. A tree 15 cm. in diameter, growing in swamp forest (*tintal*).

## MYRTACEÆ

*Calyptranthes chytraculia* (L.) Sw. Uaxactun, *Bartlett 12447*. A large shrub; common in climax forest.

*Calyptranthes millspaughii* Urban. Uaxactun, *Bartlett 12723*. A shrub or small tree 15 cm. in diameter; occasional in climax forest.

*Eugenia capuli* (Schl. & Cham.) Berg. El Paso, *Lundell 1530*; Santa Cruz, *Bartlett 12408*; Uaxactun, *Bartlett 12725*; without locality, *Cook & Martin 234*. A shrub or small tree; common in secondary upland forest, occasional in climax and swamp forest.

*Eugenia lundellii* Standl. Uaxactun-San Clemente road, *Bartlett 12801*. A slender wiry shrub or small tree 2 to 4 meters high; occasional in the central areas of swamp forest (*tintal*). It is one of the swamp species known only from the *tintal*.

At least one other species of *Eugenia* is represented by sterile material.

*Pimenta officinalis* Lindl. *Ixnabacuc*, *Pimienta gorda*, *Pimiento*. Uaxactun, *Bartlett 12328, 12343, 12762*; without locality, *Cook & Martin 80*. A small or medium-sized tree, reaching a diameter of 30 cm. and a height of 15 meters; bark smooth and almost white at times; trunk asymmetrical; common in climax forest.

*Psidium guajava* L. *Guayabo*. A shrub or small tree; common around inhabited clearings. The fruit is highly esteemed for making "dulces."

## MELASTOMATACEÆ

*Miconia ambigua* (Humb. & Bonpl.) DC. Uaxactun-San Clemente road, *Bartlett 12807*. A shrub 3 to 5 meters high; collected in swamp forest (*tintal*).

*Miconia impetiolaris* (Sw.) Don. *Hoja de queso*. Uaxactun, *Bartlett 12327*; Tikal, *Bartlett 12634*. A small tree reaching a height of 8 meters; collected in the forest covering the ruins of Tikal, and in climax forest.

## ONAGRACEÆ

*Jussiaea leptocarpa* Nutt. Lake Zotz, *Lundell 3319*. A slender herb; common in the fern and sedge bog of Lake Zotz.

*Jussiaea suffruticosa* L. Nictun, *Lundell 3156*. An herb about 1 meter high; common in wet soils, especially in clearings.

## UMBELLIFERÆ

*Fœniculum vulgare* Hill. *Eneldo*. Santa Cruz, *Bartlett 12402*. A large herb; apparently cultivated for medicinal purposes.

## ARALIACEÆ

*Gilibertia arborea* (L.) March. (?). Uaxactun, *Bartlett 12675*. A sapling, growing in climax forest.

*Oreopanax guatemalense* (Lem.) Dene. & Planch. *Mata palo*. Sabana Zis, *Lundell 3135*; Uaxactun, *Bartlett 12203*. A small to medium-sized tree; collected in marginal forest around savannas, and on hills in open climax forest.

## THEOPHRASTACEÆ

*Deherainia smaragdina* (Planch.) Dene. Fallabon-Yaxha road, *Lundell 2199*. A small tree about 8 meters high, growing in climax forest.

*Jacquinia aurantiaca* Ait. *Zincin*. Dos Arroyos, *Bartlett 12115*; Tikal, *Bartlett 12590, 12594*. A shrub or small tree, sometimes reaching a diameter of 30 cm.; collected in the forest covering the ruins of Tikal and along the bank of the stream at Dos Arroyos.

*Jacquinia axillaris* CErst. *Chacsik*. Without locality, *Cook & Martin 74*. A shrub or small tree.

## MYRSINACEÆ

*Ardisia compressa* HBK. *Ixbambul*. Tikal, *Bartlett 12626*. A slender shrub, growing in the aguada at Tikal.

*Ardisia escallonioides* Schl. & Cham. *Chiloonche*. Uaxactun-San Clemente road, *Bartlett 12800, 12812*. A tall slender shrub; occasional in swamp forest (*escobal*).

*Ardisia paschalis* Donn. Sm. *Chilil*. San Andres, *Lundell 3177*; La Libertad-Flores road, *Lundell 4337*. A slender shrub or treelet; occasional in secondary upland forest.

*Parathesis obovata* Standl. Campo Aviacion, Lake Petén, *Lundell 3112*; Santa Cruz, *Bartlett 12365*. A slender shrub 1 to 2 meters high; occasional around inhabited clearings and recently abandoned clearings.

## EBENACEÆ

*Diospyros bumelioides* Standl. A small wiry shrub or small tree; common in the central areas of *bajos*. It is a characteristic *tintal* species; not collected in Northern Petén, but undoubtedly present in the region.

*Diospyros yucatanensis* Lundell. *Jaboncillo*. Sabana Zis, *Lundell 3194*; San Andres, *Lundell 3237*, type collection. A shrub; leaves densely covered with soft fulvous pubescence; collected in marginal forest around Sabana Zis and on the bank of Lake Petén along the north shore.

## SAPOTACEÆ

*Achras chicle* Pittier. *Zapote macho*. A giant tree sometimes reaching a diameter of 120 cm. and a height of 50 meters; probably present in *corozales*.

*Achras zapota* L. *Zapote*, *Chicozapote*, *Ya*. Uaxactun, *Bartlett 12674, 12732*; without locality, *Cook & Martin 60, 135, 211, 212, 227*. A tree ranging from 20 to 120 cm. in diameter and reaching a maximum height of about 40 meters; generally a medium-sized tree of the middle tier. The species is a source of gum, fruit, and timber (see page 14).

*Bumelia mayana* Standl. *Limonaria cimarron*. Uaxactun, *Bartlett 12290, 12739*; Tikal, *Bartlett 12593*, type collection; Aguada Tigre, on Yaxha-Remate road, *Lundell 2201*. A small spiny tree about 15 cm. in diameter; common in climax forest.

*Calocarpum mammosum* (L.) Pierre. *Mamey*. A giant tree reaching a diameter of 90 cm. and a height of 40 meters; occasional in *corozales*, and sometimes planted. The large sweet fruits are much prized locally. The species requires deep soil, which probably accounts for its rarity in the part of the peninsula north of Lake Petén. According to local reports, there are large groves of the tree in southern Petén.

*Chrysophyllum cainito* L. *Caimito*. A small tree generally not more than 8 meters high; planted commonly for its fruits.

*Chrysophyllum oliviforme* L. *Zikiya*, *Siciya*. Uaxactun, *Bartlett 12276*. Ranging in size from a shrub to a large tree sometimes 20 meters in height; common in secondary upland forest, occasional in climax forest.

*Dipholis salicifolia* (L.) A. DC. *Zitzya*, *Tuulche*. Sabana Zis, *Lundell 3197*; Uaxactun, *Bartlett 12679*. Ranging in size from a shrub to an erect tree 30 cm. in diameter and 15 meters high; occasional in climax forest, and in savannas.

*Lucuma campechiana* HBK. *Kanizte*, *Limoncillo*. San Andres, *Lundell 3192*; Yaxmoxan, *Lundell 3948*; Uaxactun-San Clemente road, *Bartlett 12798*. Generally a small tree about 10 meters high, but sometimes reaching a height of 20 meters; common in climax forest, occasional in secondary upland forest.

*Lucuma durlandii* Standl. *Zapotillo*. Sayab, on Fallabon-Yaxha road, *Lundell 2154*; Uaxactun, *Bartlett 12142, 12308*. A small to medium-sized tree reaching a height of 10 meters; occasional in climax forest.

*Sideroxylon amygdalinum* Standl. *Quiebra hacha de leche*, *Pacecen*, *Pacece*, *Silion*, *Ciruelillo cimarron*. Yaxmoxan, *Lundell 3935*; Uaxactun, *Bartlett 12219, 12438, 12748*; San Clemente-Dos Arroyos road, *Bartlett 12817*. A slender tall tree reaching a diameter of 60 cm. and a height of 35 meters; common in climax forest.

*Sideroxylon meyeri* Standl. *Zapotillo macho*, *Laurelillo*. Yaxmoxan, on Remate-Yaxha road, *Lundell 3947*; Uaxactun, *Bartlett 12361, 12681*. Generally a small tree but sometimes reaching a diameter of 45 cm. and a height of 15 meters; common in climax forest.

## OLEACEÆ

*Jasminum sambac* (L.) Ait. *Jazmina*. El Paso, *Lundell 1560*. A shrub; planted for ornament.

## LOGANIACEÆ

*Cynoctonum mitreola* (L.) Britton. *Altanecia*. Nictun, *Lundell 3146*. A small herb, growing in open wet places.

*Spigelia humboldtiana* Cham. & Schl. Yaxha-Remate road, *Lundell 4263*. A small herb, growing along the road in the shade of climax forest.

*Strychnos panamensis* Seem. (?). Uaxactun, *Bartlett 12456*. A woody vine, growing in swamp forest (*escobal*).

## GENTIANACEÆ

*Limnanthemum humboldtianum* (HBK.) Griseb. Lake Petén, *Lundell 4301*. An aquatic herb with floating leaves; common in lakes.

*Lisianthus axillaris* (Hemsl.) Kuntze. *Dzitze cimarron*. Nictun, *Lundell 3153, 3159*. A slender herb, growing on the shore of Lake Petén in a low periodically flooded area.

## APOCYNACEÆ

*Aspidosperma cruentum* Woodson. *Milady colorado*. Uaxactun, *Bartlett 12570*, type collection; *12663*. A tree sometimes 30 cm. in diameter; occasional in climax forest and swamp forest.

This is the species listed as *A. sanguineum* Bartlett, a *nomen nudum* (Bartlett, 1935b).

*Aspidosperma lundellianum* Woodson. A medium-sized tree about 15 meters high; occasional in climax forest. This species was collected in Southern Campeche, and it probably occurs in Northern Petén.

*Aspidosperma megalocarpon* Muell. Arg. *Milady blanco*. Uaxactun, *Bartlett 12660*. Generally a medium-sized tree, but sometimes reaching a diameter of from 60 to 90 cm.; occasional in climax forest.

*Mesechites trifida* (Jacq.) Muell. Arg. El Paso, *Lundell 1567*. A slender vine, growing in secondary upland forest.

*Plumeria rubra* L. *Flor de Mayo*. San Andres. Planted for ornament.

*Stemmadenia donnell-smithii* (Rose) Woodson. *Cojon de caballo*, *Coyoton*. Uaxactun, *Bartlett 12556, 12557*. A medium-sized tree generally not exceeding 15 meters in height; occasional in climax forest.

*Tabernaemontana chrysocarpa* Blake. San Felipe, Campeche, *Lundell 1444*; El Paso, *Lundell 1456*. A small tree reaching a height of about 8 meters; common around *aguadas* and lakes, occasional in secondary upland forest. It appears to prefer wet soils.

*Thevetia ahouai* A. DC. *Cojon de perro*. Campo Aviacion, Lake Petén, *Lundell 3239*. A slender erect shrub 1 to 2 meters high; common in inhabited clearings and recently abandoned clearings. It appears to prefer wet soils.



*Thevetia peruviana* (Pers.) K. Sch. *Acitz*. San Andres, *Lundell 3133*. A shrub with large yellow flowers; apparently planted for ornament.

*Urechites andrieuxii* Muell. Arg. El Paso, *Lundell 1524*. A slender herbaceous or suffrutescent vine; occasional in secondary bush, riparian forest, and swamp forest.

#### ASCLEPIADACEÆ

*Asclepias curassavica* L. Nietun, *Lundell 3154*. A common herb of clearings.

*Asclepias longicornu* Benth. Tayasal, *Lundell 4060*. A perennial herb; occasional in grasslands.

*Blepharodon mucronatum* (Schl.) Dene. (?). *Cahualle*. Without locality, *Cook & Martin 51*.

*Funastrum elegans* (Dene.) Schl. Uaxactun, *Bartlett 12470*. An herbaceous vine; collected on a hill in open climax forest (*pedregal*).

*Marsdenia coulteri* Hemsl. Chato. Uaxactun, *Bartlett 12419*. A corky vine; occasional in climax forest.

*Marsdenia propinqua* Hemsl. (?). Uaxactun, *Bartlett 12555*. A large woody vine, growing in climax forest.

*Vincetoxicum barbatum* (HBK.) Standl. *Bubsak*. Without locality, *Cook & Martin 84*. An herbaceous vine.

*Vincetoxicum lundellii* Standl. El Paso, *Lundell 1518*. A slender herbaceous or suffrutescent vine; occasional in swamps and secondary upland forest.

*Vincetoxicum salvinii* (Hemsl.) Standl. (?). Uaxactun, *Bartlett 12451*. A slender vine, growing in forest on the *aguada* bank at Uaxactun.

#### CONVOLVULACEÆ

*Calonyction aculeatum* (L.) House. Uaxactun, *Bartlett 12125*. A large herbaceous vine; common in recently abandoned clearings and secondary upland forest.

*Ipomœa batatas* (L.) Lam. *Camote*. Cultivated commonly.

*Ipomœa cathartica* Poir. El Paso, *Lundell 1601*; Santa Cruz, *Bartlett 12403*; without locality, *Cook & Martin 191*. An herbaceous vine; common in *milpas* and recently abandoned *milpas*.

*Ipomœa sagittata* Lam. (?). El Paso, *Lundell 1532*. An herbaceous vine; occasional in low secondary bush.

*Ipomœa tiliacea* (Willd.) Choisy. El Paso, *Lundell 1557*. An herbaceous vine; occasional in low secondary bush.

*Ipomœa triloba* L. Campo Aviacion, Lake Petén, *Lundell 3113*. A slender herbaceous vine, growing in low secondary bush on the shore of Lake Petén.

*Jacquemontia pentantha* (Jacq.) Don. Santa Cruz, *Bartlett 12367*. A small herbaceous vine; occasional in low secondary bush.

*Merremia umbellata* (L.) Hallier. El Paso, *Lundell 1556*; Uaxactun, *Bartlett 12124*. An herbaceous vine; common in recently abandoned inhabited clearings and *milpas*.

*Quamoclit coccinea* (L.) Moench. Tayasal, *Lundell 3988*. A slender herbaceous vine; common on fences in inhabited clearings.

*Turbina corymbosa* (L.) Raf. Santa Cruz, *Bartlett 12410*. A suffrutescent vine; occasional in low secondary bush.

#### HYDROPHYLLACEÆ

*Hydrolea spinosa* L. Santa Cruz, *Bartlett 12368*. An herb, growing in swampy places.

*Nama jamaicense* L. San Benito, *Aguilar 162*. A prostrate annual; common in inhabited clearings.

#### BORAGINACEÆ

*Beureria oxyphylla* Standl. *Roble*. Uaxactun, *Bartlett 12537*. A medium-sized tree sometimes reaching a diameter of almost 1 meter; occasional in climax forest.

*Cordia diversifolia* Pavon. *Chiquax*. Arroyo Kantetul, *Lundell 3165*. A slender tree 4 meters high, growing on the bank of the dry stream at Kantetul.

*Cordia ferruginea* (Lam.) Roem. & Schult. El Paso, *Lundell 1461, 1579*. A large subscandent shrub; common in low secondary bush.

*Cordia glabra* L. Laguna Perdida, *Lundell 1659*. A small to medium-sized tree generally not exceeding 12 meters in height; common in secondary upland forest, occasional in climax forest.

*Heliotropium angiospermum* Murray. Yerba Martin. Yaxha, Lundell 2211. An erect herb; common in inhabited clearings.

*Tournefortia hirsutissima* L. El Paso, Lundell 1463; Uaxactun, Bartlett 12128, 12134, 12508. A large scandent shrub; common in secondary upland forest (guamil).

*Tournefortia peruviana* Poir. Ixlu, Lundell 4070. A slender scandent shrub, growing along the road in the shade of climax forest (ramonal).

## VERBENACEÆ

*Ægiphila monstrosa* Moldenke. El Paso, Lundell 1492. A shrub 1 to 2 meters high; occasional in secondary upland bush.

*Bouchea prismatica* (L.) Kuntze. San Benito, Aguilar 166. An erect annual; common in inhabited clearings.

*Callicarpa acuminata* HBK. Remate, Lundell 2088. A shrub 1 to 3 meters high; common in inhabited clearings and recently abandoned clearings.

*Clerodendron ligustrinum* (Jacq.) R. Br. San Pedro de Martir River, Lundell 1472. A shrub 1 to 3 meters high with long slender branches; common on swampy banks.

*Cornutia pyramidata* L. (?). Latche. Without locality, Cook & Martin 128.

*Lippia dulcis* Trev. Lake Zotz, Lundell 3302; without locality, Cook & Martin 204. A small perennial herb; common in clearings.

*Lippia myriocephala* Schl. & Cham. Tah. Kantetul, Lundell 3171. A small erect tree 3 to 6 meters high; common around savannas in marginal scrub forest. This species is prominent in the scrub forest overrunning Sabana Kantetul.

*Lippia nodiflora* (L.) Michx. Orozús. Nictun, Lundell 3149. A small creeping perennial herb; common on the shore of Lake Petén in periodically flooded areas.

*Lippia reptans* HBK. El Paso, Lundell 1544. A sprawling herb; common in inhabited clearings.

*Lippia stachadifolia* (L.) HBK. San Pedro de Martir River, Lundell 1471; Uaxactun, Bartlett 12736; without locality, Cook & Martin 199. Large sprawling suffrutescent plant; common along the wet banks of the river, in inhabited clearings, and in recently abandoned clearings.

*Petrea volubilis* L. Uaxactun, Bartlett 12133, 12559, 12566. A large woody vine sometimes 10 cm. in diameter; occasional in climax forest, secondary upland forest, and swamp forest (escobal). The blue flowers are very showy and the species is commonly planted for ornament.

*Priva lappulacea* (L.) Pers. Uaxactun, Bartlett 12162. A small annual; common in inhabited clearings. At Uaxactun it was collected on the dry sandy bed of Arroyo Uaxactun.

*Rehdera penninervia* Standl. & Moldenke. (*Citharexylum pinninervium* Standl., *nomen nudum*.) Palo blanco. Uaxactun, Bartlett 12317, type collection. A tree 70 cm. in diameter; bark light brownish, closely split longitudinally, becoming pulverulent; heart-wood mahogany colored. Occasional in tall swamp forest (botanal).

*Stachytarpheta cayennensis* (L. Rich.) Vahl. Verbena. Reported by Standley in his *Flora of Yucatan* as occurring in Petén.

*Stachytarpheta jamaicensis* (L.) Vahl. Verbena. Without locality, Cook & Martin 205. A large erect herb; common in inhabited clearings.

*Vitex gaumeri* Greenm. Yaaxnic, Yaxnic. El Paso, Lundell 1509; Uaxactun, Bartlett 12733. Generally a small to medium-sized tree but sometimes reaching a diameter of 70 cm. and a height of 20 meters; common in climax forest and secondary upland forest.

## LABIATÆ

*Hyptis capitata* Jacq. El Paso, Lundell 1453. A coarse herb; common in fields and inhabited clearings.

*Hyptis verticillata* Jacq. El Paso, Lundell 1454. A tall coarse herb; common in fields and inhabited clearings.

*Hyptis* sp. El Paso, Lundell 4421. A slender woody vine; occasional in secondary bush. This is an undescribed species according to Dr. Epling.

*Ocimum micranthum* Willd. Uaxactun-San Clemente road, Bartlett 12795. An annual, growing in the road shaded by climax forest.

*Salvia coccinea* L. var. *pseudococcinea* Gray. Tabaquillo. Santa Cruz, Bartlett 12370. An erect herb; common in inhabited clearings.

*Salvia lavanduloides* HBK. (?). El Paso, Lundell 1596. A low subshrub; planted for ornament.

*Salvia obscura* Benth. El Paso, Lundell 1545. An erect herb; common in inhabited clearings.

*Teucrium inflatum* Sw. *Verjena*. Yaxha, *Lundell 2209*; Nictun, *Lundell 3148*; Uaxactun, *Bartlett 12120*. An herb; very common in inhabited clearings and other open places such as lake banks.

## SOLANACEÆ

*Capsicum macrophyllum* (HBK.) Standl. *Ixchayuc*. Uaxactun, *Bartlett 12518*. A shrub 3 to 4 meters high; occasional in low secondary bush.

*Capsicum viscidum* Standl. *Chanico*. Uaxactun, *Bartlett 12690*, type collection. A shrub 3 to 4 meters high; occasional in low secondary bush.

It is certain that several cultivated forms of *Capsicum* occur in Northern Petén, but none was collected.

*Cestrum nocturnum* L. *Xacabyoom*, *Dama de noche*. Remate, *Lundell 2017*; Macanche, *Lundell 4253*; without locality, *Cook & Martin 194*. A shrub 2 to 4 meters high; very common in low secondary bush.

*Cestrum panamense* Standl. *Izac-hawaii*, *Dama de noche*. Laguna Perdida, *Lundell 1650*; Uaxactun, *Bartlett 12175*, *12743*. A small to medium-sized tree; common in secondary upland forest, occasional in swamp forest.

*Lycianthes hypoleuca* Standl. Yaxmoxan, on Yaxha-Remate road, *Lundell 3986*. A subscandent shrub, growing at edge of clearing at Yaxmoxan.

*Lycianthes lenta* (Cav.) Bitter. Fallabon, *Lundell 2151*. A slender vine, growing in the inhabited clearing on the river bank.

*Lycianthes variifolia* Standl. Ixlu, *Lundell 4006*. A scandent shrub, growing in secondary bush.

*Lycopersicum esculentum* Mill. *Tomate*. Commonly cultivated.

*Nicotiana tabacum* L. *Tabaco*. San Benito, *Aguilar 59*. Cultivated in yards to a limited extent.

*Physalis lagascæ* Roem. & Schult. El Paso, *Lundell 1563*, *1590*. An erect annual herb; common in inhabited clearings.

*Solanum appendiculatum* Dunal. (?). *Chilmikaac*, *Chilankaak*. Without locality, *Cook & Martin 52*, *157*.

*Solanum bicolor* Willd. Yaxha, *Lundell 2012*. A shrub 1 to 2 meters high; very common in inhabited clearings.

*Solanum diversifolium* Schlecht. El Paso, *Lundell 1448*; Remate, *Lundell 2074*. A prickly shrub 1 to 3 meters high; common in inhabited clearings and recently abandoned clearings.

*Solanum erythrorichum* Fernald. La Libertad-Flores road, *Lundell 4004*. A shrub; occasional in secondary upland bush.

*Solanum hirtum* Vahl. El Paso, *Lundell 1584*. A coarse prickly subshrub about 1 meter high; occasional in recently abandoned clearings.

*Solanum lanceifolium* Jacq. El Paso, *Lundell 1460*, *1465*; Yaxha-Remate road, *Lundell 2203*; Uaxactun, *Bartlett 12478*. A prickly woody vine; common in low secondary bush, occasional in inhabited clearings.

*Solanum nigrum* L. *Ixchayuc*, *Yerba mora*. El Paso, *Lundell 1512*; Santa Cruz, *Bartlett 12385*; Uaxactun, *Bartlett 12767*. An herb; common in inhabited clearings and recently abandoned clearings.

*Solanum nudum* HBK. *Cuchillo-xiu*. Campo Aviacion, Lake Petén, *Lundell 3224*; Uaxactun, *Bartlett 12706*. A large shrub; common in low secondary bush.

*Solanum verbascifolium* L. Santa Cruz, *Bartlett 12399*. A shrub 2 to 3 meters high; occasional in secondary upland forest.

*Solanum wendlandii* Hook. f. *Ixcán*. San Benito, *Aguilar 161*. A woody vine; planted for ornament.

## SCROPHULARIACEÆ

*Capraria biflora* L. Yaxha, *Lundell 2013*, *2212*; Uaxactun, *Bartlett 12463*; without locality, *Cook & Martin 206*. An erect herb not more than 1 meter high; common in inhabited clearings.

*Russelia campechiana* Standl. Laguna Perdida, *Lundell 1644*; Yaloch, *Bartlett 12852*. A suffrutescent vine with long slender sprawling branches; occasional in secondary upland forest.

*Russelia* sp. Uaxactun, *Bartlett 12263*. A slender perennial herb; occasional in low secondary bush.

## LENTIBULARIACEÆ

*Utricularia macerrima* Blake. (?). Lake Zotz, *Lundell 3369*. A small aquatic herb; common around the edges of the fern and sedge bog of Lake Zotz.

*Utricularia obtusa* Sw. (?). Lake Petén, *Lundell 2085*; Lake Zotz, *Lundell 3272*. A small aquatic herb; common in lakes.

## BIGNONIACEÆ

*Adenocalymna fissum* Loes. Uaxactun, *Bartlett 12567*. A large woody vine with violet flowers, growing in climax forest.

*Adenocalymna* sp. El Paso, *Lundell 1554*. A large woody vine; occasional in secondary upland forest.

*Amphilophium molle* Schl. & Cham. Sohbach. Uaxactun, *Bartlett 12440*. A large woody vine; occasional in climax forest.

*Arrabidaea lundellii* Standl. A large woody vine; generally common in secondary upland forest and occasional in climax forest. The species has not been collected in Northern Petén, but it undoubtedly will be found there, for it is common in adjacent areas to the north, east, and south.

*Callichlamys latifolia* (A. Rich.) Schum. Boxak, *Bejuco negro*. Uaxactun, *Bartlett 12439*. A large woody vine; occasional in climax forest.

*Clytostoma mayanum* Standl. Ixlu, *Lundell 4007*; Yaxha-Remate road, *Lundell 4008*, type collection. A large woody vine; occasional in climax forest.

*Cuspidaria pterocarpa* (Cham.) DC. (?). Fallabon-Yaxha road, *Lundell 2193*. A woody vine, growing in climax forest.

*Cydista diversifolia* (HBK.) Miers. El Paso, *Lundell 1489*. A woody vine; occasional in climax forest and secondary upland forest.

*Parmentiera edulis* DC. Aguada Tigre, on Yaxha-Remate road, *Lundell 2079*. A small tree about 8 meters high; occasional in climax forest.

*Tabebuia pentaphylla* (L.) Hemsl. Maculiz. Uaxactun, *Bartlett 12340*. A large tree reaching a diameter of 60 cm.; occasional in climax forest.

## GESNERIACEÆ

*Codonanthe confusa* Sandwith. El Paso, *Lundell 1501*. An epiphyte on a dead tree in the river.

## ACANTHACEÆ

*Aphelandra deppeana* Schl. & Cham. El Paso, *Lundell 1447*; San Clemente-Dos Arroyos road, *Bartlett 12827*. A shrub 1 to 2 meters high; common in climax forest, occasional in swamp forest (*escobal*).

*Beloperone aurea* Leonard. Fallabon-Yaxha road, *Lundell 2189*, type collection. A shrub 2 to 3 meters high; common along roadside in the shade of climax forest.

*Blechnum pyramidatum* (Lam.) Urb. Uaxactun, *Bartlett 12247*. An herb, growing in swamp forest (*escobal*); generally a common weed around inhabited clearings.

*Jacobinia spicigera* (Schl.) L. H. Bailey. El Paso, *Lundell 1549*. A small shrub; occasional in secondary bush.

*Justicia breviflora* (Nees) Rusby. Macanche, on Yaxha-Remate road, *Lundell 4096*. A shrub; occasional along roadside in shade of climax forest.

*Justicia comata* (L.) Lam. El Paso, *Lundell 1609*. A slender herb; common in clearings on wet river banks.

*Louleridium donnell-smithii* Wats. Sayab, on Fallabon-Yaxha road, *Lundell 2081*; without locality, Cook & Martin 79. A small tree 4 to 8 meters high; common on a hillside at Sayab.

*Odontonema callistachyum* (Schl. & Cham.) Kuntze. Uaxactun, *Bartlett 12156*; Santa Cruz, *Bartlett 12389*; Laguna Perdida, *Lundell 1646*. A shrub 1.5 to 2 meters high; occasional in secondary upland forest and swamp forest (*botanal*).

*Pseuderanthemum alatum* (Nees) Radlk. Uaxactun, *Bartlett 12305*. An herb; occasional in climax forest.

*Ruellia nudiflora* var. *yucatanica* Leonard. El Paso, *Lundell 1516*; Nictun, *Lundell 3216*. A small perennial herb; common in inhabited clearings and open areas such as periodically flooded lake banks.

*Ruellia stemonacanthoides* (Erst.) Hemsl. Yaxha-Remate road, *Lundell 4094*; Uaxactun, *Bartlett 12160*; Santa Cruz, *Bartlett 12388*. A shrub 2 to 3 meters high; common in climax forest.

*Stenandrium subcordatum* Standl. *Pocchericac*. Uaxactun, *Bartlett 12283*. A small herb; collected on the dry sandy bed of Arroyo Uaxactun.

*Thunbergia alata* Bojer. El Paso, *Lundell 1598*. A slender vine; planted for ornament.

#### RUBIACEÆ

*Alibertia edulis* (L. Rich.) A. Rich. *Guayabillo*. San Andres, *Lundell 3175*. A slender shrub 2 to 4 meters high; common in climax forest and secondary upland forest.

*Borreria lævis* (Lam.) Griseb. *Zic-chichibe*. Uaxactun, *Bartlett 12246, 12705*. A slender herb; common in inhabited clearings, occasional in wooded swamps along trails.

*Borreria verticillata* (L.) Mey. *Antaniza*. Nictun, *Lundell 3150*; Dos Arroyos, *Bartlett 12105*; San Benito, *Aguilar 27*. A perennial herb or subshrub sometimes 1 meter high; generally common in wet places around inhabited clearings, occasional in swamps and secondary upland forest.

*Chiococca alba* (L.) Hitchc. Pueblo Nuevo, Lake Petén, *Lundell 4203*. A woody vine; common in secondary upland forest.

*Coffea arabica* L. *Cafe*. Cultivated in yards to a limited extent. Most coffee is brought into Petén from Alta Vera Paz.

*Geophila herbacea* (Jacq.) Schum. Uaxactun, *Bartlett 12530*. A small prostrate creeping herb; common on the floor of climax forest and taller swamp forest (*botanal*). Often the plants are almost entirely hidden beneath the fallen leaves.

*Guettarda gaumeri* Standl. A slender shrub 2 to 3 meters high; occasional in swamp forest.

*Hamelia patens* Jacq. *Chac-ixkanan*, *Xkanan*. Uaxactun, *Bartlett 12180*; without locality, *Cook & Martin 132, 148*. A shrub 1 to 3 meters high; common in inhabited clearings and recently abandoned clearings.

*Hamelia rovirosæ* Wernham. El Paso, *Lundell 1600*. A shrub 1 to 2 meters high; occasional in low secondary bush.

*Morinda yucatanensis* Greenm. San Andres, *Lundell 3143*; Santa Cruz, *Bartlett 12398*; Dos Arroyos-Yaloch road, *Bartlett 12842*; without locality, *Cook & Martin 184*. A slender scandent shrub or woody vine; common in secondary upland forest, occasional in swamp forest (*escobal*).

*Psychotria alba* R. & P. *Ixpit-balum*. Uaxactun, *Bartlett 12533*. A shrub or small tree; occasional in swamp forest (*botanal*).

*Psychotria chiapensis* Standl. Yaloch-El Cayo road, *Bartlett 12864*. A shrub 3 meters high; occasional in climax forest.

*Psychotria flava* (Erst.) Laguna Perdida, *Lundell 1643*; La Libertad-Flores road, *Lundell 4202*; Tikal, *Bartlett 12633*; Uaxactun-San Clemente road, *Bartlett 12809*; San Clemente-Dos Arroyos road, *Bartlett 12834*. A shrub 1 to 4 meters high; common in swamp forest, climax forest, and secondary upland forest.

*Psychotria fruticetorum* Standl. Macanche, on Yaxha-Remate road, *Lundell 4252*; Santa Cruz, *Bartlett 12397*; San Clemente-Dos Arroyos road, *Bartlett 12819, 12824, 12835*. A small shrub generally not exceeding 1.5 meters in height; common in climax forest, occasional in swamp forest (*escobal*).

*Psychotria granadensis* Benth. Uaxactun, *Bartlett 12534*. A shrub or treelet; occasional in swamp forest (*botanal*).

*Psychotria limonensis* Krause. La Libertad-Flores road, *Lundell 4226*; Uaxactun, *Bartlett 12205*. A shrub or treelet; occasional in climax forest and secondary upland forest.

*Psychotria ærstediana* Standl. El Paso, *Lundell 1577*; Uaxactun, *Bartlett 12722*. A slender shrub 1 to 2 meters high; occasional in climax forest and *aguada* bank forest.

*Psychotria pubescens* Sw. *Zac-ixkanan*. San Andres, *Lundell 3176*; Uaxactun, *Bartlett 12139, 12177, 12700*. A shrub 1 to 3 meters high; common in climax forest and secondary upland forest.

*Psychotria sessilifolia* Mart. & Gal. Uaxactun, *Bartlett 12136, 12223*; Santa Cruz, *Bartlett 12395A*. A small shrub; common in climax forest and secondary upland forest.

*Psychotria undata* Jacq. *Sacxanal*. Uaxactun, *Bartlett 12244, 12686*; without locality, *Cook & Martin 149*. A shrub 1 to 3 meters high; occasional in swamp forest (*escobal*) and secondary upland forest.

*Randia armata* (Sw.) DC. San Andres, *Lundell 3117*. A woody vine, growing on the bank along the north shore of Lake Petén.

*Rondeletia belizensis* Standl. *Bakke*. Sabana Zis, *Lundell 3188*. A slender shrub or small tree 3 to 7 meters high; common in the marginal scrub forest around Sabana Zis.

*Sickingia salvadorensis* (Standl.) Standl. *Chactemuch*. Uaxactun, *Bartlett 12428*. A tall slender tree reaching a height of 18 meters; occasional in climax forest and secondary upland forest.

## VALERIANACEÆ

*Valeriana scandens* L. San Clemente-Dos Arroyos road, Bartlett 12828. A small herbaceous vine; collected on a rocky slope in open climax forest.

## CUCURBITACEÆ

*Anguria aurantiaca* Blake. (?). *Tres Marias de guia*. Without locality, Cook & Martin 159.

*Anguria diversifolia* Cogn. Uaxactun, Bartlett 12229. A vine in climax forest.

*Cayaponia microdonta* Blake. Uaxactun, Bartlett 12336. A vine; occasional in climax forest.

*Cucurbita moschata* Duch. Calabaza. Cultivated commonly in milpas and yards.

*Cucurbita radicans* Naud. Nictun, Lundell 3152; San Andres, Lundell 3202. An herbaceous vine; occasional in inhabited clearings and other open places.

*Elaterium ciliatum* Cogn. El Paso, Lundell 1539. A small herbaceous vine; common in inhabited clearings on fences.

*Lagenaria siceraria* (Molina) Standl. *Bux*, *Lec*. San Andres, Lundell 3936, 3939, 4266, 4284. A large herbaceous vine; cultivated commonly in yards and milpas. The fruit reaches a diameter of 30 cm.; the *bux* variety is round or only slightly pear-shaped, while the *lec* variety is constricted in the center. The latter is used for water bottles, and the former serves for containers and various vessels. The utensils made from the gourds are excellent substitutes for many types of clay containers.

*Melothria guadalupensis* (Spreng.) Cogn. El Paso, Lundell 1588; Uaxactun, Bartlett 12299. A slender herbaceous vine; common on fences in inhabited clearings.

*Sicydium tamnifolium* (HBK.) Cogn. Chacmots. Uaxactun, Bartlett 12461; without locality, Cook & Martin 131. A slender herbaceous vine; common around inhabited clearings and in low secondary bush.

## LOBELIACEÆ

*Isotoma longiflora* (L.) Presl. El Paso, Lundell 1481. A small erect perennial herb; common in inhabited clearings.

*Lobelia berlandieri* A. DC. (?). Uaxactun, Bartlett 12221. An herb, growing on the dry sandy bed of Arroyo Uaxactun.

## COMPOSITÆ

*Ageratum corymbosum* Zuccag. var. *latifolium* (DC.) Robinson. Nictun, Lundell 3145. A slender herb; common on the open bank of Lake Petén in periodically flooded areas.

*Ageratum houstonianum* Mill. Fallabon, Lundell 2196. A slender herb; common on muddy river banks at low water time.

*Baccharis trinervis* (Lam.) Pers. El Paso, Lundell 1455; Lake Zotz, Lundell 3305; Santa Cruz, Bartlett 12391. A large suffrutescent plant 1 to 3 meters high with long slender clambering branches; common in low secondary bush covering abandoned clearings.

*Bidens pilosa* L. Mozote. El Paso, Lundell 1510; Nictun, Lundell 3137; Tayasal, Lundell 4017; Uaxactun, Bartlett 12738. An erect herb about 1 meter high; common in open areas, clearings, and recently abandoned clearings. Several varieties are represented.

*Brickellia oliganthes* (Less.) Gray. Tayasal, Lundell 4013. A perennial herb; common in grasslands.

*Calea trichotoma* Donn. Sm. Nictun, Lundell 3158. A coarse herb; occasional in open places along the shore of Lake Petén.

*Calea urticifolia* (Mill.) DC. Kantetul, Lundell 3174. A subshrub about 1.5 meters high; common in the scrub forest overrunning Sabana Kantetul.

*Cirsium mexicanum* DC. Cardosanto. Uaxactun, Bartlett 12126. A large coarse herb; common in milpas and low secondary bush.

*Eclipta alba* (L.) Hassk. El Paso, Lundell 1523, 1547. An erect herb; common in clearings on wet river banks.

*Egletes viscosa* (L.) Less. El Paso, Lundell 1543; Uaxactun, Bartlett 12132. A small viscid-pubescent annual; common along roads and in clearings through swampy places. During the dry season, it is probably the commonest herb growing in roads through the swamps.

*Eleutheranthera ruderalis* (Sw.) Sch. Bip. Thamacas. Flores, Lundell 3180. An herb; cultivated for medicinal purposes.

*Epaltes mexicana* Less. El Paso, *Lundell* 1508. A small herb; common on river bank clearings in wet soils.

*Erechtites hieracifolia* (L.) Raf. Lake Zotz, *Lundell* 3294. A coarse erect herb; occasional in the fern and sedge bog of Lake Zotz.

*Eupatorium albicaule* Sch. Bip. Lake Petén, *Lundell* 4011; Yaxha-Remate road, *Lundell* 4016. A large suffrutescent plant with slender clambering branches; occasional in low secondary bush.

*Eupatorium macrophyllum* L. *Arepaxiu*. El Paso, *Lundell* 1483; Laguna Perdida, *Lundell* 1649; Santa Cruz, *Bartlett* 12378; San Clemente-Dos Arroyos road, *Bartlett* 12826; without locality, *Cook & Martin* 220. A coarse herb 1 to 2 meters high; common in low secondary bush, occasional in swamp forest (*escobal*).

*Eupatorium morifolium* Mill. Laguna Perdida, *Lundell* 1645. A large clambering shrub 2 to 3 meters high; occasional along the lake shore in secondary bush.

*Eupatorium odoratum* L. El Paso, *Lundell* 1570; Dos Arroyos, *Bartlett* 12101. Large suffrutescent or woody plant 2 to 3 meters high; occasional in secondary bush and swamp forest (*tintal*).

*Eupatorium pycnocephalum* Less. Uaxactun, *Bartlett* 12278. An erect herb about 1 meter high; collected on the dry sandy bed of Arroyo Uaxactun.

*Goldmanella sarmentosa* Greenm. El Paso, *Lundell* 1580. A perennial herb growing in dense patches; occasional in secondary upland forest.

*Harleya oxylepis* (Benth.) Blake. El Paso, *Lundell* 1533; Fallabon, *Lundell* 2197. A perennial, subscandent herb; occasional in swamp forest and on wet river banks.

*Liabum dimidium* Blake. Tikal, *Bartlett* 12602, type collection. A large suffrutescent plant with branches scrambling to a height of 6 meters; occasional.

*Liabum* sp. Yaxha-Remate road, *Lundell* 2202. A shrub, growing in shade of climax forest.

*Melampodium gracile* Less. La Libertad-Flores road, *Aguilar* 25. An erect herb; occasional in secondary bush.

*Melanthera deltoidea* Michx. San Benito, *Aguilar* 409. An herb; occasional in inhabited clearings and recently abandoned clearings.

*Melanthera nivea* (L.) Small. Tayasal, *Lundell* 4015. A coarse erect perennial herb about 1 meter high; common in inhabited clearings, occasional in grasslands.

*Mikania micrantha* HBK. El Paso, *Lundell* 1527. A scandent herb; occasional in low secondary bush.

*Montanoa pauciflora* Klatt. El Paso, *Lundell* 1537; Santa Cruz, *Bartlett* 12411. A large suffrutescent vine or scrambler; common in low secondary bush.

*Neurolæna lobata* (L.) R. Br. *Yaxta*, *Ocuayin*. Uaxactun, *Bartlett* 12519; without locality, *Cook & Martin* 78. A tall coarse herb; common around inhabited clearings and in recently abandoned clearings.

*Orthopappus angustifolius* (Sw.) Gleason. Tayasal, *Lundell* 4014. A slender perennial herb; occasional in grasslands.

*Otopappus scaber* Blake. San Andres, *Lundell* 3200; Uaxactun, *Bartlett* 12275. A coarse scandent suffrutescent plant; occasional in open areas, inhabited clearings, and low secondary bush.

*Perymenium peckii* Robins. Dos Arroyos, *Bartlett* 12110. An herb, growing along the road through swamp forest.

*Pluchea odorata* (L.) Cass. El Paso, *Lundell* 1581; Remate, *Lundell* 2030; without locality, *Cook & Martin* 192. A shrub 1.5 to 2 meters high; common in inhabited clearings and recently abandoned clearings.

*Pseudelephantopus spicatus* (Juss.) Rohr. Santa Cruz, *Bartlett* 12363. A coarse erect herb; common in clearings, occasional in marginal thickets and low bush.

*Schistocarpha oppositifolia* (Kuntze) Rydb. Uaxactun, *Bartlett* 12264. A coarse herb 2 meters high; occasional in inhabited clearings and recently abandoned clearings.

*Senecio kermesinus* Hemsl. Campo Aviacion, Lake Petén, *Lundell* 4012. A scandent herb; occasional in secondary bush.

*Spilanthes americana* (Mutis.) Hieron. El Paso, *Lundell* 1449; Lake Zotz, *Lundell* 3301; Uaxactun, *Bartlett* 12774. A slender herb; very common on wet soils in open places.

*Trixis radialis* (L.) Kuntze. El Paso, *Lundell* 1586. A large subscandent suffrutescent plant; common in low secondary bush.

*Vernonia aschenborniana* Schauer. Dos Arroyos-Yaloch road, *Bartlett* 12844; Yaloch, *Bartlett* 12854. A subscandent shrub 1.5 to 3 meters high; occasional in secondary upland forest and swamp forest (*escobal*).

*Vernonia tortuosa* (L.) Blake. Lake Zotz, *Lundell* 1651. A large subscandent shrub; common in low secondary bush.



*Viguiera dentata* (Cav.) Spreng. var. *helianthoides* (HBK.) Blake. *Makatze*. Nictun, *Lundell 3160*. A coarse herb; occasional on the shore of Lake Petén in open areas.

*Wedelia acapulcensis* HBK. (?). Nictun, *Lundell 3127*. A slender perennial herb; occasional on the shore of Lake Petén in open areas.

*Wedelia adhærens* Blake. Dos Arroyos, *Bartlett 12111*. An herb; common in wooded swamps, especially along trails.

*Wedelia filipes* Hemsl. El Paso, *Lundell 1506*. A slender herb 1 to 2 meters high; common in low secondary bush on the wet river bank in a spring-fed area.

*Wedelia parviceps* Blake. Dos Arroyos, *Bartlett 12108*. An herb; common in wooded swamps, especially along trails.

*Zexmenia serrata* Llave. Lake Zotz, *Lundell 3306*; Uaxactun, *Bartlett 12235*; Santa Cruz, *Bartlett 12396*. A woody scandent herb; common in secondary bush, occasional in swamp forest (*escobal*).

## CENTRAL PETÉN SAVANNA COUNTRY

### DESCRIPTION OF THE REGION

#### GEOLOGY

According to Sapper (1899) a tongue of Cretaceous limestone extends from the mountains of Chiapas eastward into central Petén. The boundaries of the savanna country appear to coincide with the eastern boundaries of the Cretaceous beds.

North and south of the savanna region, the deposits are supposedly Tertiary. If the observations of Sapper are substantiated, then the Central Petén Savanna Country is geologically distinct from Northern Petén and the region on the south.

#### TOPOGRAPHY AND DRAINAGE<sup>1</sup>

As shown in a cross-section made by Sapper (1899), the savanna country, comprising the central area between Lake Petén and the Subin River, lies on a low dome which reaches a height of about 175 meters in the vicinity of La Libertad.

This savanna section is characterized by numerous broad, level, grassy flatlands which are intersected by conical, forested and denuded hills of resistant limestone (Plates 23 and 24). The hills range from 10 to 80 meters in height; some are isolated domes, others are more or less connected, forming long, irregular, narrow ranges.

Scattered through the flatlands are numerous sinkholes, most of which are surrounded by bush which ranges from small clumps of scrubby growth to high sub-climax forest (Plates 25 and 35). The sinkholes may be grouped into two classes: (1) those with underground outlets, and (2) those which retain water permanently or at least for long periods. The latter are the *aguadas* which have probably been formed through plugging of the underground outlets. The sinkholes in general have gently sloping banks, and very few of them exceed two meters in depth (Plates 33 and 34). The region is karst-like, and almost entirely underdrained through the sinkhole outlets. There are no lakes or streams in the area covered by the 1933 expedition.

<sup>1</sup> Stuart (1935, p. 11) gives a more detailed description of certain phases of the savanna country physiography.

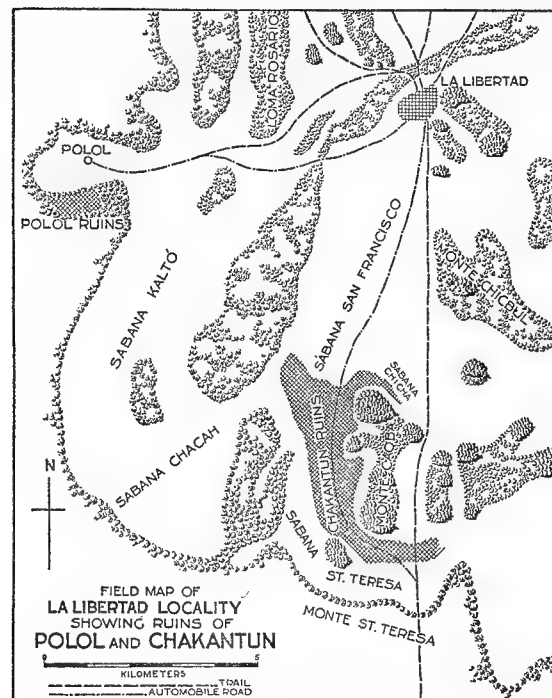


FIG. 1—Map of La Libertad region

## CLIMATE

The meteorological records from the savanna country are scant.<sup>1</sup> At La Libertad rainfall records were kept by Ulrich Schröder for 10 months in 1930 and by L. C. Stuart from April 1 to June 15, 1933. During the 1930 period there were 2047 mm. of precipitation (Sapper, 1931), while the total rainfall from April 1 to June 15, 1933 was 553.5 mm. (Stuart, 1935). The 1930 total exceeds the general average at El Paso (table 1, p. 6). Although these available data indicate a rainfall comparable to that of adjacent areas, no definite conclusions can be drawn until records are made for a period of years.

It is possible that the savanna country of central Petén is a pocket with an average rainfall less than in Northern Petén and southern Petén, yet having occasional wet years as in 1930. To the west of the savannas lie the mountains of Chiapas, to the south the mountains of Alta Vera Paz, and on the east the Maya Mountains of British Honduras. To the north the region is bounded by the elevated Yucatan tableland. The tableland scarcely exceeds 400 meters in height, yet that possibly is sufficient to influence climatic conditions.

Although no definite conclusions can be reached until actual meteorological records are made, there is the possibility that the savanna country of central Petén is a rain-shadow area. However, that possibility is remote, for the undisturbed forest of the savanna country compares favorably with that of adjacent quasi-rain-forest areas and hence indicates a comparable rainfall.

As in all of the Yucatan Peninsula there is a marked seasonal distribution of rainfall which divides the year into a wet season from May through October, and

<sup>1</sup> For additional information on climatic conditions of the region in general, refer to Huntington (1912), Sapper (1931, 1932), Page (1933), Lundell (1934), Stuart (1935), and page 6 in this volume.

a dry season from November through April. Rainfall from November to February is sufficient so that the vegetation generally does not suffer from lack of moisture, but during March and April there may not be a drop of rain. This is the critical period when many species lose their leaves and fires sweep the country. In some years with severe extended dry seasons, February and May are almost rainless also.

The vegetation as a result of these extreme climatic conditions and fire destruction is quite variable, ranging from fire-resistant thorny gnarled xerophytic to mesophytic quasi-rain-forest types. It is during the critical dry season that the striking differences in the vegetation are most apparent, hence ecological classification is much easier at that time.

Even though temperature records are not available for comparison, the average temperature should not vary much from that of the El Paso station (Sapper, 1931, 1932). However, I expect that the maximum is higher. From March to June 1933 the savanna country was an oven. During that time the sun appeared as a red ball, being almost obscured by smoke from the fires which swept the grasslands and forested areas.

#### SOILS

Soil samples of the region around La Libertad were collected by L. C. Stuart in 1933. His observations in the field, pertaining to the depth and appearance of distinguishable soil layers as well as to their reaction expressed in pH, are given in table 2. The observations were mostly made in test-pits especially dug for the purpose to a depth below which the material seemed uniform. The actual depths, limited by practical exigencies, ranged from 90 to 120 cm., in pits numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 15, 16, and 17 without reaching bedrock. A newly dug well afforded observations to a depth of 870 cm., again without reaching solid bedrock (pit no. 10). Limestone bedrock was encountered only in pits numbers 12, 13, 14. Samples were taken from each distinguishable layer separated at stated depths. These samples are indicated by the letters a, b, c, etc., added to the serial pit numbers. No systematic attempt has been made to designate the various layers according to the terminology now in use among pedologists.

The samples were brought to the University of Michigan and turned over to Dr. M. W. Senstius of the Department of Geology who intends to publish a detailed soil report with chemical as well as mineralogical analyses. To date, he has completed the mechanical analyses, using the Bouyoucos method (Bouyoucos, 1930), and made preliminary observations on color, structure, etc. The method of mechanical analysis used is claimed by the originator to correspond, in results, to the separation into the standard "grades" (*i.e.* sand, silt, and clay) adopted by the U. S. Bureau of Chemistry and Soils for its textural classification of soils. Accordingly, "class" names have been assigned to the various soils in conformity with the official scheme of classification (Davis and Bennett, 1927). Dr. Stuart and Dr. Senstius have very kindly permitted me to include the data which I present in table 2.

TABLE 2.—Analyses of Certain Soils from the Central Petén Savanna Country

Ecological zone	Serial No.	Depth in cm.	pH	Mechanical analyses (Bouyoucos method)			Class name	Color under air-dry laboratory conditions	Comments
				Total sand p. ct.	Total silt p. ct.	Total clay p. ct.			
Well-drained grassland	1a	0 to 7	5	27.6	22.4	50.0	Clay	Chestnut-brown	Lumpy; humus considerable; plant roots present; crushable with rolling pin; pebbles few.
	1b	7 to 42	5 to 6	19.6	15.0	65.4	Clay	Reddish-yellow	Smaller lumps; no humus; roots few; easily crushable between fingers.
	1c	42 to ?	5	15.6	8.4	76.0	Clay	Light reddish-yellow	Small lumps; no humus; few stray roots; easily crushable between fingers; no pebbles.
Dry basin of Aguada San Francisco	2a	0 to 7	4 to 5	21.6	18.8	59.6	Clay	Dark gray	Compact large lumps, dark gray on surface; matrix darker gray, streaked with orange-yellow; root fragments present; rolled lumps break apart into angular crumbs.
	2b	7 to 42	5 to 6	19.6	12.8	67.6	Clay	Dark gray	Same color and structure as 2a; lumps smaller and darker upon fracture, with orange to red streaks; no roots; easily crushed by rolling pin into angular crumbs.
	2c	42 to 72	5	11.2	5.8	83.0	Clay	Light gray	Light gray lumps smaller than in 2a and 2b, which when broken show orange and red streaks and occasionally black (MnO <sub>2</sub> ?) spots; easily crushed between fingers.
	2d	72 to ?	5	17.2	2.8	80.0	Clay	Light brownish-gray	Light brownish-gray lumps with gray mottled fragments; easily broken up with fingers.
Dry basin of Aguada Chicah	3a	0 to 7	4	17.2	10.0	72.8	Clay	Dark gray	Dark gray lumps, surface mottled orange-brown; matrix darker bluish-gray, mottled brown-red; root fragments present; lumps break up between fingers; no pebbles or gravel.
	3b	7 to 35	5	12.8	14.4	72.8	Clay	Dark gray	Same as 3a except that lumps are smaller, more friable, with reddish-orange mottling; no roots.
	3c	35 to 40	5 to 6	12.8	7.6	79.6	Clay	Light yellow-gray	Smaller light yellow-gray lumps; matrix light bluish-gray, with irregular orange-yellow streaks and red spots; porous inside.
	3d	40 to ?	6	11.2	8.4	80.4	Clay	Light gray	Like 3c, but light gray; red spots on surface and within lumps; easily crushed by fingers.
Dry basin of Aguada Chachalum	4a	0 to 12	4 to 5	21.8	18.8	59.4	Clay	Light yellow-brown	Light yellow-brown lumps; macroscopic dark-brown rounded concretions at surface; some organic matter.
	4b	12 to 40	6	20.8	15.4	63.8	Clay	Light yellow-brown	Same as 4a except that the more compact lumps upon breaking show black (MnO <sub>2</sub> ?) and orange blotches.
	4c	40 to 58	6	14.8	22.8	62.4	Clay	Orange to brown	Orange to brown smaller lumps with streaks of dark violet and light yellow, as well as gray blotches.
	4d	58 to ?	6 to 7	12.8	17.8	69.4	Clay	Variegated red-orange to gray	Variegated gray, red-orange lumps with black and red blotches.
Aguada bank	5a	0 to 15	5	24.8	19.2	56.0	Clay	Light yellow-brown	Light yellow-brown lumps with brick-red streaks and films on surface; root fragments present.
	5b	15 to 20	6	32.8	14.8	52.4	Clay	Yellow-brown	Yellow-brown smaller lumps with typical black coating; variegated at surface probably by MnO <sub>2</sub> ; no organic matter.
	5c	20 to 60	6 to 7	14.8	18.4	66.8	Clay	Reddish-yellow-brown	Smaller reddish-yellow-brown lumps with variegated black coatings; no organic matter.
	5d	60 to ?	6 to 7	14.4	18.8	66.8	Clay	Reddish-yellow-brown	Lumps larger than in 5c, yellowish-reddish-brown with gray interior, and occasional black films in spots; no organic matter.

Flatland high forest	6a	0 to 10	5	24.8	16.4	58.8	Clay	Dark gray-brown	Dark gray-brown lumps with reddish cast; organic matter and roots present in whole mass.
	6b	10 to 25	5 to 6	17.2	10.0	72.8	Clay	Chocolate-brown	Small chocolate-brown lumps with reddish cast, lighter than 6a; small shot-like black (MnO <sub>2</sub> ?) particles present.
	6c	25 to 60	6	12.8	8.4	78.8	Clay	Light brick-red	Small lumps of light brick-red color with gray spots; no organic matter.
	6d	60 to ?	5 to 6	14.6	8.6	76.8	Clay	Light brick-red	Same as 6c.
Marginal forest	7a	0 to 7	5	13.6	18.8	67.6	Clay	Light brown	Light brown large lumps; roots present.
	7b	7 to 20	5 to 6	13.6	12.8	73.6	Clay	Brown with brick-red cast	Small crumb lumps, easily broken between fingers; brown with distinct brick-red cast.
	7c	20 to 55	5 to 6	11.6	8.8	79.6	Clay	Brick-red	Brick-red crumb lumps with yellow cast; black pebbles present.
	7d	55 to ?	5 to 6	13.6	10.8	75.6	Clay	Yellowish-brick-red	More yellowish, brick-red crumb lumps, easily crushed between fingers; black pebbles few.
Well- drained grassland	8a	0 to 20	5 to 6	17.2	10.4	62.4	Clay	Light brown	Light brown lumps with reddish cast; roots present; lumps can be broken, but not readily pulverized.
	8b	20 to 55	5 to 6	13.6	10.8	75.6	Clay	Light yellowish-brown	Light yellowish-brown lumps, easily crushed between fingers; roots few; buckshot-like concretions present.
	8c	55 to ?	5	12.0	8.4	79.6	Clay	Pale reddish-yellow	Pale reddish-yellow lumps, easily crushed between fingers; buckshot-like concretions common.
Flatland high forest	9a	0 to 7	5 to 6	23.2	14.0	62.8	Clay	Chestnut-brown	Hard large lumps, uniformly chestnut-brown; matrix with black MnO <sub>2</sub> (?) spots; organic matter and roots present.
	9b	7 to 22	5 to 6	17.2	12.0	70.8	Clay	Light brown	Smaller hard lumps, lighter brown; more MnO <sub>2</sub> (?) concretions.
	9c	22 to 55	5	12.8	9.2	78.0	Clay	Yellow-brown	Small lumps, light yellow-brown with reddish cast; black and red concretions.
	9d	55 to ?	5	11.2	8.8	80.0	Clay	Yellow-brown	Same as 9c.
Flatland (Inhabited clearing)	10a	75 to 540	7	16.4	20.4	63.2	Clay	Reddish-yellow	Reddish-yellow mottled lumps. The sample was taken at a depth of 450 cm. from a well being dug in La Libertad.
	10b	540 to ?	6	16.8	12.0	71.2	Clay	Grayish-yellow	Grayish-yellow lumps mottled with blue. Sample taken from same well at depth of 870 cm.
Hill cap forest	12	0 to 30	8					Very dark gray to black	Dark gray-black soil found in pockets of outcropping limestone; largely a mass of humus and tangled roots with some ash.
Limestone valley forest	13a	0 to 22	8	15.2	10.8	74.0	Clay	Dark gray	Very dark gray; lumps very hard and irregular; some organic matter.
	13b	22 to 30	7	13.2	6.8	80.0	Clay	Dark gray	Lighter dark gray; hard smaller lumps with limestone fragments; no organic matter visible except perhaps through color.
	13c	22 to 100	8	Limestone powder and pebbles				Light gray	Some light gray soil, but mostly gray-yellow-white pieces of limestone.
Hill cap forest	14	0 to 35	8					Very dark gray to black	Dark gray-black soil much like 12.
Flatland forest	15a	0 to 22	6 to 7	21.2	14.8	64.0	Clay	Dark reddish-brown	Hard, dark reddish-brown lumps which can not be crushed between fingers.
	15b	22 to 47	5	13.2	10.8	76.0	Clay	Reddish-brown	Same as 15a.
	15c	47 to ?	4 to 5	13.2	8.8	78.0	Clay	Light red	Small light red or salmon-colored lumps.
Well-drained grassland (?)	16a	0 to 42	5	17.2	18.8	64.0	Clay	Light gray-brown	Dull light gray-brown; hard large lumps; some organic matter.
	16b	42 to 75	5	9.2	12.8	78.0	Clay	Salmon-colored	Dull salmon-colored; hard large lumps; no organic matter.
	16c	75 to ?	5	9.2	10.8	80.0	Clay	Salmon-colored	Dull salmon-colored; small lumps crushable between fingers; no organic matter.
Well- drained grassland	17a	0 to 7	5 to 6	14.4	15.6	70.0	Clay	Brick-red	Hard dull brick-red lumps, some small, some large; rolling revealed MnO <sub>2</sub> (?) specks; roots few.
	17b	7 to ?	5	12.0	6.0	82.0	Clay	Brick-red	Hard dull brick-red small lumps, with distinct shot-like concretions; some roots.

The soils may be divided into two major types: (1) immature, and (2) mature. To the former group belong the shallow soils covering the hills and limestone valleys. Test-pits 12, 13, and 14 in table 2 represent the immature, local, limestone soils which are technically known as *rendzina*. Test-pits 12 and 14 were made on hill tops where the soil mantle ranges from a scant covering to 35 cm. in thickness. This hill soil is gray-black in color, being largely a mixture of humus, tangled roots, and limestone fragments. Stuart noted some ash and charred remains in test-pit 12, evidence of fire in past years. The forest on the hills is a low, somewhat xerophytic, characteristic type (p. 148).

Test-pit 13 was made in a limestone valley about 15 meters from the base of a hill. The top layer, extending to a depth of 22 cm., was dark gray containing considerable organic matter. The second layer, lying between 22 and 30 cm., was likewise dark gray, but somewhat lighter in color than the upper layer. Little or no organic matter was visible, except perhaps that suggested by the color. Both 13a and 13b were stiff clays. The lower layer (13c), extending to bedrock or to a depth of about 100 cm., was light gray and characterized by numerous pieces of gray-yellow-white limestone which increased in number as the bedrock was approached. This deeper *rendzina* soil is comparable to those commonly found in gently sloping areas and valleys throughout the Yucatan Peninsula. It supports luxuriant quasi-rain-forest in little-disturbed humid sectors. The shallow *rendzina* soil such as is found in test-pits 12 and 14 is likewise widely distributed, covering all the hills of the limestone country.

Where denudation has taken place, the *rendzina* soil is generally red instead of dark gray, probably owing to destruction of the organic matter. All *rendzina* soils sampled in central Petén had pH values ranging from 7 to 8, neutral to slightly alkaline.

The mature flatland soils, by far the most extensive in central Petén, may be subdivided into: (1) undrained and (2) well-drained types. The former comprise the small *aguadas* and limited areas of swampy savanna (*bobolares*), while the latter occupy or are found on the broad plains, in part forested, but covered mostly with grasslands.

Three test-pits, numbers 2, 3, and 4 in table 2, represent mature undrained *aguada* soils. The general characteristics of the soils of Aguada San Francisco and Aguada Chicah may be briefly summarized. They are strongly acid in the upper layers and acid to neutral in the deeper layers. All are very stiff clays cracking deeply in the dry season, or when the basins dry out. For at least nine months of each year they are water-logged, hence lacking in proper aeration. Occasionally the remaining three months are dry, during which time oxidation can take place. The lack of aeration is evidenced by the variegated colors (mottling) of the lower layers. These soils are similar in color, being dark gray in the surface layers and light gray in the deeper layers. Reducing processes prevail in the soils rather than oxidation, thus giving *glei* types which are typical of areas subject to the influence of ground water.

The soil of Aguada Chachacluum (4) is similar to that of the other two as regards acidity and the tendency to crack, but differs in color and coarser texture. The soil in Aguada San Francisco and Aguada Chicah is dark gray, while the color is yellow-brown in Aguada Chachacluum. The differences may be accounted for by the fact that this *aguada* is quite shallow and probably dry for much longer periods than the other two, hence better aerated. The soil appears to have similarities to certain types encountered in the well-drained flatlands.

Summarizing, then, the characteristics of the *aguada* soils are as follows: (1) they are stiff clays with clay content increasing with depth; (2) they crack deeply upon drying; (3) they are *glei* soils as evidenced by the light gray, mottled, poorly aerated subsurface layers; (4) they are strongly acid on the surface, becoming less acid in depth; (5) they range in color from dark gray to yellow-brown, the latter color found in temporarily flooded shallow *aguadas*, the former in *aguadas* holding water for at least nine months each year; and (6) they support a characteristic herbaceous growth. They may be classed as water-logged clays.

No samples of soils of swampy grasslands were taken. In the field, they closely resemble those of the *aguadas*.

Test-pits 4 to 8 in table 2 illustrate the sequence of soils in the section from the center of the basin of Aguada Chachacluum, through the surrounding flatland forest, to the grasslands. Test-pit 4 is in the *aguada* basin, test-pit 5 the *aguada* bank, test-pit 6 the flatland high forest, test-pit 7 the marginal forest, and test-pit 8 the well-drained grasslands. The vegetation of this section is discussed on page 115 and diagrammed in figure 2.

The *aguada* bank soil, represented in test-pit 5, is quite similar to that of the basin of Aguada Chachacluum in color and acidity. Considerable aeration takes place in the upper layers, but the lower layers apparently are water-logged for long periods. The soil does not crack even in long severe dry seasons, probably because of the presence of considerable organic material.

The other soils of the flatlands may all be classed as well-drained. Test-pits 6 and 9 are on flatland high forest around Aguada Chachacluum, and Aguada Yaxnic in Monte Chicbul. The surface layers vary from dark gray-brown to chestnut-brown. The lower layers in the former are chocolate-brown to light brick-red, while in the latter they range downward from light brown to yellow-brown. In both, the organic matter in the top layer is considerable, in fact it masks the red color to a marked extent. The soil is stiff acid clay with concretions in spots common throughout the horizons. As in practically all the mature flatland soils, clay content increases with depth. No cracking was observed.

The vegetation cover is high humid mesophytic forest which continually blankets the floor with leaves.

The marginal forest soils, tests 7 and 15, vary in color on the surface from light brown to dark reddish-brown with the lower layers mostly red. Test 7 was made in the marginal forest around Aguada Chachacluum and the soil there is an acid clay all through the section, crumb-like in structure. Test 15 was made in



marginal forest near the base of a hill. It is likewise a clay, but neutral in the surface layer and acid in the lower layers. The neutrality of the surface is probably due to calcareous water and limy soil particles washed from the adjacent hill. It is not surprising, therefore, in some places to find certain calciphile hill species such as *Rondeletia belizensis*, *Protium copal*, *Hirtella americana*, etc., growing on the flatlands at the bases of hills. Some organic matter is indicated perhaps by the brownish colors.

The well-drained grasslands form the most extensive plant community of the region. Tests 1, 8, 16, and 17 were made in different localities. The surface soils vary from chestnut-brown over gray-brown to brick-red. The darker soils certainly contain considerable humus which may account for the color. The vigorous grassy vegetation and the long dry seasons each year favor its accumulation. The content of organic matter varies considerably from place to place as evidenced by the wide range of colors of the surface layers. Test 17 apparently shows little or no organic matter as judged by the color. The subsurface layers range from yellow-brown to brick-red. All the grassland soils are acid clays in which concretions (hydrated  $\text{Fe}_2\text{O}_3$ , and  $\text{MnO}_2$ ?) are common. They did not crack during the severe drouth of 1933.

In the single deep test-pit (10), a well being dug in the village of La Libertad, the flatland soil exceeded 870 cm. in thickness and may have been much thicker, since bedrock had not yet been encountered at the greatest depth. One layer, extending from a depth of about 75 to 540 cm., was reddish-yellow in color with considerable mottling, which is evidence of poor aeration. The deeper layer began at a depth of about 540 cm. and extended to the bottom of the well, which was dug to a depth of 870 cm. The soil of this thick layer was yellowish-gray upon drying. When first dug it was mostly blue; however, the blue changed rapidly to yellowish-gray on exposure, probably as a result of rapid oxidation. It was very evident that the deeper layer had little or no aeration.

The following pertinent facts stand out in regard to the mature well-drained flatland soils: (1) they are predominantly acid in all layers; (2) all are clays with the clay content increasing with depth; (3) the surface layers are brownish to brick-red, the subsurface layers are yellow-brown to brick-red; (4) the organic matter, considerable in general (judging by the color), masks the red color in the surface layers; (5) this organic matter prevents cracking; (6) the high percentage of clay undoubtedly leads to excessive evaporation in periods of drouth; (7) poor aeration is evidenced in the lower layers by mottling and gray-blue color; and (8) concretions (hydrated  $\text{Fe}_2\text{O}_3$ , and  $\text{MnO}_2$ ?) are common.

Detailed laboratory tests are necessary to determine the differences between the types of soils in the various ecological zones. Studies on moisture conditions, structure, content of organic matter, etc., will reveal highly important data concerning edaphic conditions.

In general there is good correlation between certain types of soils and plant communities, as will be shown under the section "Classification of the Vegetation"

beginning on page 98. One of the highly important studies of the future will be to determine the edaphic changes which take place as various successional stages of the vegetation invade the grasslands. Also soil conditions which follow retrogression of the vegetation in sections disturbed by fire and *milpa* agriculture should be critically studied to determine the effect of the disturbances on soil fertility and correlated micro-organic life, humus depletion, moisture conditions, structure, etc.

The origin of the immature *rendzina* soils of the hills and limestone valleys can be accounted for by natural processes of weathering from limestone and accumulation *in situ*. However, the manner in which the flatland clays have been formed is a matter of conjecture. The following assumptions concerning their manner of formation should be considered merely as suggestions.

One possibility is that the thick clays may be the result of weathering *in situ*. As Stuart (1935, p. 13) states, it is very probable that the limestone which once covered this region was not uniform in composition but contained local beds of very resistant material. When the karst cycle was carried to completion in a manner such as outlined by Sanders (1921), the purer limestones were dissolved and broken down to the deep clays now present, whereas the more resistant beds remained to form the characteristic limestone hills.

A second possibility is that the deep clays have been deposited in natural depressions or in subsidence basins through erosion from the uplands. Cooke (1931) thus accounts for the silting of the *bajos* in Northern Petén, which he assumes were once shallow lakes.

Dr. Senstius, in examining the soil samples, has found evidence of layering which would indicate that water-borne material has been deposited in the flatlands. Further, the very high percentage of clay particles indicates that the soils may have been deposited in water.

There remains a third possibility that both processes, *i. e.* formation *in situ* and accumulation by inwash, have taken place alternately.

The similarity of the flatlands to the *bajos* (wooded swamps) of Northern Petén has strongly impressed me, for drainage of the shallow basins of the *bajos* would certainly leave deep clay plains very similar to the broad savanna flatlands. Although surface streams are absent, drainage of the savanna country is nevertheless complete. Solution of the underlying bedrock has resulted in numerous sink-holes (dolines) through which the drainage mostly takes place. If the *bajos* should be similarly drained, their basins would be broad deep clay flatlands.

The under-drainage of the savanna flatlands is possibly the result of rejuvenation since the karst cycle was completed. There is the possibility that this new cycle of erosion has been occasioned by the subsidence of the southern Petén basin (Sapper, 1894, 1896, 1899) as well as subsidence of the area to the north wherein lie Lake Petén, Laguna Perdida, and the San Pedro de Martir River. Such subsidence of the adjacent areas would make possible under-drainage and subsurface erosion.

Further evidence that the savanna flatlands may be analogous to the *bajos* is found in the vegetation. The *palo tinta*, *Hæmatoxylum campechianum*, is restricted to *bajos* generally, yet occasional individuals of this species are found scattered through the open grasslands. Likewise, the *nanze*, *Byrsonima crassifolia*, and the *saha*, *Curatella americana*, grow both in *bajos* and in the savannas. Edaphic conditions of the savannas and the *bajos* appear to be similar in many respects, such as acidity, high clay content, physiological dryness due to high evaporation and the hygroscopic state of much of the water, poor aeration in deeper layers, etc. That drainage would change the *glei* soils of the *bajos* to red-yellow-brown types such as are encountered in the savanna flatlands is not only possible but plausible as well. The soil in the basin of Aguada Chachacluum appears to be a transitional type intermediate between the *glei* soil of certain *aguadas* and the soil of well-drained flatland areas.

#### MAYA OCCUPATION

The broad deep clay flatlands of central Petén may have been forested when the first Indians entered the area. However, there is no definite proof to back this assumption concerning conditions which existed thousands of years ago. If the plains were forested, then we can account for the denudation either by climatic changes or destructive influences of man. I favor the latter factor, for forest could exist under undisturbed conditions with a rainfall considerably less than the area is now estimated to receive. The fact that high mesophytic forest exists in parts of the flatlands today in spite of prolonged dry seasons and fires is evidence enough to show that forest growth probably has been restricted by factors other than climate.

If the flatlands were forested when the first Indians arrived, it is not difficult to surmise what took place. With continued *milpa* rotation and fire destruction, the tempo of retrogression of the vegetation increased to the point where small grassy areas came into existence. In fact, retrogression may have been quite rapid for the deep clay soils do not appear to support as vigorous forest growth as the limy *rendzina* soils which cover the greater part of the peninsula. The grasslands spread as the remaining forested sections were denuded through fire and agriculture. Under resulting conditions, grasslands were more favored than forest. Thus the savannas of today probably came into existence. Considering the type of soil of the plains, fire destruction, and recent grazing, it is not difficult to account for the perpetuation of the grasslands, even in a humid climate.

Whether it was the early Maya who felled the central Petén flatland forest, or their predecessors, is a question that will be difficult if not impossible to answer. The innumerable house mounds dotting the savannas impress the fact that every square kilometer was occupied at one time or another. Although excavations will have to be undertaken to determine the period to which they belong, there is at least a probability that many of the habitations date from the so-called Old Empire. That central Petén was occupied during that time is evidenced by dated stelæ in Polol, Itsimte, and the Lake Petén ruins.

From historical data we know that central Petén was densely populated from the fifteenth through the eighteenth century, when Tayasal was the cultural center of the Itzas (Means, 1917). To the Tayasal period such extensive ruins as those of Chakantun are tentatively referred, pending excavations to determine their actual historical position.

Whether or not the clay plains of central Petén were ever cultivated by the Maya is a question to be considered, but the answer is doubtless affirmative. The fact that scattered house mounds exist in every square kilometer indicates that the land surrounding these must have supported the agriculturists who occupied them.

Assuming that the house mounds are remains of Maya habitations, we may postulate that the savanna lands were once cultivated by the Maya.<sup>1</sup> Then the question arises as to what system of agriculture was employed: (1) the *milpa* or (2) a method of breaking the sod. The possibility that the people lived in the savannas as at present and had their *milpas* in *rendzina* soil areas surrounding the region must also be considered.

If the savanna flatlands were still forested during Old Empire times, then the *milpa* system was probably in general use. Increase of the population, shorter cycles of *milpa* rotation, and retrogression of the vegetation to grassy growth may have occurred during the Great Period, the epoch in which the Polol, Itsimte, and Lake Petén cities flourished. The savannas in that case would date from about 10.0.0.0.0 (A. D. 570 or 829). The house mounds, therefore, may represent *milpero* habitations.

If, however, savanna conditions have been much the same throughout Maya history as today, then the scattered habitations could be accounted for by another type of agriculture, *i.e.* breaking of the sod. The possibility of this is contingent on whether a higher agricultural system than that of the *milpa* was developed.

The savanna soils are fertile; they yield satisfactory crops with the removal of grasses and other weedy growth. In small fenced areas, several persons in La Libertad are reported locally to have obtained exceptional yields of beans and corn. They broke only the soil surface with hoes before planting. In the house plots of the village there are excellent gardens and orchards. Throughout the village grow fruit trees which attain greater size than I have observed elsewhere in the Maya area (Plate 31).

In the past, during either the Old Empire or Tayasal period, these savanna soils may have been extensively cultivated. Cattle were not present then to necessitate fencing. The scattered habitation remains and evidences of small settlements may, therefore, have been homes of stationary agriculturists who had house plots, orchards, and cultivated patches in the well-drained flatlands.<sup>2</sup>

The possibility that present conditions were in existence then is not to be overlooked. Today there are large agricultural settlements such as La Libertad,

<sup>1</sup> There is the possibility that some of the ruins in the savanna country may represent pre-Maya ("archaic") or post-Conquest habitations.

<sup>2</sup> There is no proof whatever that the Maya cultivated land by turning the sod. I advance the suggestion merely as a possibility that has to be taken into consideration.

Chachacluum, and Chiche located in the open savanna. The *milpas* of the La Libertad people are in Monte Santa Teresa, Monte Chacah, Monte Polol, and Monte Chimah (Plate 1 and fig. 1). The inhabitants of Chiche have their *milpas* north of the savanna country. The making of their *milpas* outside of the savanna area is necessitated by the cattle industry. Thousands of cattle, mules, and horses range through the grasslands, and only the strongest fences keep them out of fields, therefore it is less labor under present conditions to make *milpas* in the surrounding forested *rendzina* soil areas where yields are high and cattle are not a menace. The distance of their fields from their homes appears to mean little to Maya agriculturists.

It is of interest to note the proximity of the ruins of Chakantun, Polol, and Itsimte to *rendzina* soil areas. In the past as at present, the Maya may have lived scattered through the savanna, having their *milpas* in the forested *rendzina* soil country surrounding the savanna country.

We may, therefore, account for savanna ruins in three ways: (1) that the plains were forested and that the remains represent *milpero* habitations, (2) that the savannas have existed as today from the beginning of the Maya culture, thereby indicating that scattered habitations were built by agriculturists who cultivated the well-drained flatlands, or (3) that people built their homes around *aguadas* in the savannas as at present, yet had their fields in the *rendzina* soil areas surrounding the region.

#### FIRE CONDITIONS AND GRAZING

During the severe dry season of 1933, fires were very destructive in central Petén. Some areas of the grasslands burned over three times within two months. The first extensive fires came in March, then the grasses sprouted out vigorously only to be burned again late in April. Some areas were overrun a third time in May. Each fire left the grasslands as black charred plains (Plate 22).

Needless to say, the grassland fires swept through the marginal bush. However, a majority of the species of the marginal zone appear to be fire-resistant, so that damage was not exceptionally severe there. It is probable that the marginal forest serves as a buffer zone to a large degree intercepting the fire before it reaches the mesophytic forest. Destruction of marginal forest leads to retrogression of bordering mesophytic forest.

The 1933 dry season must have been exceptional, for blazes not only swept the grasslands and marginal bush, but also entered the mesophytic forest of the flatlands and limestone valleys and ran over the hills. According to general opinion, fires are not supposed to do much damage in humid broad-leaved mesophytic forest, but as a matter of fact, they may be very destructive in years with prolonged rainless dry seasons. In 1933 such flatland high forest areas as Monte Chicbul and Aguada Chachacluum were swept by ground fires which damaged the underwood considerably. In Monte Hiltun, Monte Polol, Monte Chimah, and in the forest between the village of Cimarron and Lake Petén, fires almost

denuded certain areas. As in the grasslands, some sections were swept twice during the same season.

In Monte Hiltun where bamboo thickets abound, fire swept through the forest early in April (Plate 38). The heat was so intense that it killed most of the leaves on the trees and also seared many trunks so that the non-fire-resistant species died. Some, partially decayed from damage in previous years, burned to hollow shells and collapsed. Soon after the first fire, leaves fell profusely, mantling the ground. Within a month another ground fire ran through the woods, and many trees which had stood the previous onslaught burned and fell then. In fact, the destruction in this forest during the 1933 dry season was so severe that repetition for several years would undoubtedly result in denudation.

During April and May it was almost impossible to travel from La Libertad to Lake Zotz or Lake Petén because the roads were so badly blocked by fallen trees.

As in the valleys and flatlands, fires also wrought havoc on the hills, killing and defoliating the vegetation (Plate 23, fig. 1). That probably accounts for the denuded hills (Plate 23, fig. 2). At night for almost two months fires could be seen burning along the hill slopes and caps.

Smoke from the incessant fires clouded the sky so that the sun appeared as a red ball. In fact, smoke conditions were so bad that air mail service was discontinued between Flores and Guatemala City for six weeks in April and May 1933.

Blazes in the savanna country are set largely by cattlemen to improve grazing conditions. Almost every cattleman carries a box of matches during the dry months just for that purpose. Although grassland fires sweep into the adjacent forest, some blazes in the bush are due to *milpa* burnings. When the *milpas* were burned at Polol, destruction in the adjacent areas was so severe that the secondary bush was almost completely killed. In fact denudation took place to the extent that *milperos* planted corn in areas where they had not felled a single tree.

As previously noted, the dry season of 1933 was said to be exceptional. Litter in the forest and areas of the grasslands which had not burned during the three previous wet years became tinder during the rainless months and its ignition led to wide-spread destruction.

The burning of grasslands each year by cattlemen is probably a favorable factor in reforestation. Annual fires prevent long accumulation of dry straw and litter, thus resulting in less destruction. With moderate ground fire conditions, forest appears to be able to invade the grasslands slowly, hence unwittingly the cattlemen are aiding reforestation.

My opinion is that fire conditions such as were witnessed in 1933, coupled with *milpa* agriculture rotation, were the factors which led to denudation and the formation of grasslands in central Petén.<sup>1</sup> In regard to this, Cook's statement (1909) is noteworthy.

"To invoke other than the human agencies to account for the present lack of forests in many parts of Central America is superfluous, for the destructive abilities of the Indians

<sup>1</sup> For an excellent discussion of the rôle of fire in the destruction of vegetation, refer to Humbert's paper on Madagascar (1927).

are everywhere in evidence. Reforestation is everywhere going on, but the Indians are also busy cutting down and burning the woody vegetation. If the burning over of the land were limited to areas ready for planting the general results would be far less disastrous, but the fires are usually allowed to spread wherever there is fuel to carry them, and large tracts of land are thus kept in a permanently barren condition. At night in the farm-clearing season the burning mountain slopes gleam with lines of light like the streets of distant cities. By day the sky is darkened and the air is heavy with smoke. That regions now so barren as the valley of Salama in central Guatemala may be artificial deserts cleared by human agency can readily be understood when the facts are viewed at first hand. The devastation which can be worked in a single corn-planting season will go far to convince the careful observer that the native methods of agriculture have wide-reaching effects."

My experiences agree with these observations of Cook.

Cattle roam the grasslands of the savanna country in droves, yet the area does not appear to be overgrazed. Grazing during the wet season is said to be very excellent as one may well judge from the condition of the animals. In the dry season there is some scarcity of forage, although the hardy perennial grasses sprout out vigorously after each fire. Grazing undoubtedly has some effect on the vegetation, but no studies were made on this phase of the problem. At the present time the results of firing by cattlemen are probably more important on the vegetation as a whole than grazing or any other factors.

#### CERTAIN GENERAL ASPECTS OF THE VEGETATION

On the basis of soils, the savanna country may be divided into two major divisions: (1) deep clay areas and (2) *rendzina* areas. The former comprise the broad flatlands, the latter the hills and narrow valleys.

The vegetation of the deep clay flatlands consists of two major types: (1) grassland and (2) forest, both well-drained. Minor vegetation types are those associated with sinkholes and swampy grassland. Well-drained grassland, the distinctive feature of the phytogeographical division, supports a complex herbaceous flora. A majority of the species, at least in the dry season, are hardy perennials adapted to fires, drouth, and edaphic conditions, having underground woody stems, fleshy roots, stolons, bulbs, or other structures to tide them over the unfavorable dry season. The annuals thrive during the wet months. The low trees, shrubs, lianas, and epiphytes found in the grasslands are fire and drouth-resistant xerophytes, widely distributed in such areas throughout Central America.

Among the 160 plants collected in the grasslands, not a single endemic species was discovered. We can account for this in two ways: (1) either the savannas represent denuded forest lands or (2) the endemics have not survived the severe fires. The absence of endemics among all the collections to date in the grasslands is one of the noteworthy features which I am inclined to interpret as indicating that the savannas represent denuded forest lands. This opinion is substantiated by faunal conditions concerning which Stuart (1935, p. 32) says:

"... Hence, it may be concluded that forest types dominate in the savanna region as a whole. This, it seems to me, is a rather weighty argument favoring the conclusion that the savannas are of comparatively recent origin."



For further discussion of this matter see Stuart (1935, pp. 26-27).

The grassland flora is much the same as that encountered in similar areas in adjacent regions. A majority of the species are represented in the pine-land flora of British Honduras. Many of the plants are commonly found in savannas throughout Central America. We can conservatively assume that the savannas are at least 500 years old, a period which appears to have been sufficient for a complex and interesting flora of adaptable species to become firmly established.

Grasses dominate the *campo* to the extent that I have termed the vegetation a short grass deflected climax association. Legumes rank next in importance.

Among the most interesting features of the grasslands is the existence there of stunted, distorted trees which are represented in nearby forest by tall erect individuals. The outstanding example of such a species is *Dipholis salicifolia*. In the grasslands it is a low, gnarled, fire-resistant tree, while on nearby hills the same species is a tall, erect, handsome timber tree typical of mesophytic forest. The exposure in the open savanna with its drying winds, high rate of evaporation, insolation, greater transpiration, along with edaphic conditions probably account largely for the great physiognomic differences. Dry season conditions in the grasslands are decidedly xerophytic.

The forest of the deep clay flatlands may be divided into three zones: (1) marginal, (2) flatland high forest, and (3) *aguada* bank (classified under undrained sinkholes). The first habitat could be considered xerophytic, the two latter more or less mesophytic. *Aguada* bank forest is relatively unimportant in extent, compared with that of the other two zones.

The marginal forest bordering the grasslands is composed largely of deciduous species resistant to fire, drouth, and exposure. Many are thorny, wiry, few-branched, and gnarled (Plate 36). The leaves of most species are variously adapted to xerophytic conditions.

The flatland high forest, on the other hand, approaches in luxuriance the quasi-rain-forest of Northern Petén. It may be classed as mesophytic. Some of the trees exceed 30 meters in height and layering is well developed.

*Aguada* bank forest is mostly tall and evergreen, being shrubby only bordering the *aguada*. Whereas fire and exposure probably are the chief factors accounting for the scrubby xerophytic marginal growth around the savanna edge, the shrubby growth of the *aguada* edge is probably due more to edaphic conditions.

The forest of the flatlands as a whole exhibits certain interesting features. One which impressed me most was the physiognomic variations of the same species. Although the three major zones and the belts in each of these zones have species almost entirely restricted to the limited area, many species are distributed throughout. In the marginal zone an aggregate of species may exhibit xerophytic features, yet 25 meters farther into the forest almost the same group of species will be mesophytes as luxuriant as the evergreens restricted to the mesophytic forest. The adaptability of species to varied climatic and

edaphic conditions as well as fire enables them to become established among the pioneers and survive to become important elements in climax forest. Among such flatland forest species showing this adaptability are *Matayba oppositifolia*, *Bursera simaruba*, *Metopium brownei*, *Spondias mombin*, *Guettarda combsii*, *Calyptranthes chytraculia*, *Hirtella racemosa*, *Alibertia edulis*, *Cnestidium rufescens*, *Nectandra* spp., *Vitex gaumeri*, *Simaruba glauca*, *Zanthoxylum* spp., and *Ficus* spp.

The flora of the marginal forest is closely related to that of the *sequelar*, a similar marginal (tension) zone separating the coniferous and broad-leaved forest of British Honduras concerning which Bartlett (1935, p. 20) states:

" . . . A *sequelar* is typically the transitional plant association which in British Honduras lies between the climax mahogany-sapodilla ridge and the pine ridge. In it there is a mixture of certain adaptable species from the *corozal*, *zapotal* or mahogany-sapodilla ridge with others from the *pinar*, and a very great change in the dominant types. Species which are inconspicuous elements in one of the other formations become important in the *sequelar*. . . ."

It also resembles the secondary dry forest of Northern Yucatan in many respects.

The marginal vegetation in the savanna country is undoubtedly the result of unnatural conditions which have arisen from denudation and the establishment of grasslands. When retrogression of the forest lands reached the grassland stage, the species of secondary stages in the original mesophytic forest were no longer able to establish themselves to reclaim the denuded areas, probably because of the inability of the seedlings to survive the fires, or changed edaphic and climatic conditions. The grasslands became deflected climax areas. Around the margins of sinkholes and hills, woody species, which could survive the extremes to which the borderlands are subjected, gained a foothold. Some species more or less suppressed in the forested areas were undoubtedly favored by the new conditions, hence became the characteristic marginal species. Other widely distributed cosmopolitan species came in and thrived in the habitat. The establishment of the many diverse species now so prominent in the marginal forest must have been a slow process. The manner in which the species have been dispersed would form an interesting study. Many such as *Conostegia xalapensis*, *Simaruba glauca*, and *Ximenia americana* have edible fruits which may have led to dispersal by birds and other animals.

The species confined primarily to the flatland high forest and *aguada* bank forest may be relics of the ancient forest which have survived in small areas of secondary forest. However, most are species commonly encountered in the forest of areas adjacent to the savanna country.

An important feature of the flatland forest is the scarcity of endemics, which is further proof that the flatland vegetation is secondary and adventive.

Of the minor vegetation types, those associated with the sinkholes and swampy grasslands are of most importance. They are discussed on pages 110 and 104.

The question whether or not reforestation of the grasslands is taking place may be answered in the affirmative in my opinion. Concerning the invasion of grasslands by woody growth in Central America, Cook (1909) states:

"In some localities it is evident that the woody vegetation may make a slow and gradual conquest, even in spite of occasional fires, if sufficient time is allowed and no new clearings are made. Many localities which are now open grass country or are covered with scattering pines, oak, or *Curatella* trees are being reforested by dense tropical vegetation, wherever the opportunity is afforded by a cessation of cutting and burning."

My studies on the savannas of central Petén indicate that forest is invading the grasslands. There the annual fires now set by cattlemen are generally not so severe that the woody growth can not make headway. It is certain that the rainfall is sufficient to support forest as is evidenced by the areas of high mesophytic growth now present (Plate 35).

In the reforestation it is the dynamic fire-resistant marginal-zone species which pave the way for the establishment of mesophytic forest. The marginal zone appears to serve also as a buffer belt protecting the inner humid zone from fire. An important study of the future will be to determine if there is a correlation of edaphic conditions with the various successional stages of invading vegetation.

The mesophytic stages of the secondary sere following the displacement of the thorn scrub and other marginal stages may or may not represent stages of the primary sere. So far no areas of undisturbed climax forest have been discovered in the savanna country from which conclusions could be drawn.

The second major division of the savanna country is that of the *rendzina* soil areas, the limestone hills, valleys, and mounds, practically all of which are forested. In Sabana Chacah and in the savannas east of La Libertad, there are a number of denuded hills and mounds covered with sparse herbaceous growth and woody clumps (Plate 23, fig. 2), but considering the entire region, they are relatively insignificant.

The forested limestone hills are covered in general with low trees, although high forest is occasionally encountered. The specific composition and physiognomy of the hill slope and hill cap floras vary sufficiently so that two closely related but distinct habitats are recognizable. Ground fires running over the hills have resulted in considerable local variations which I recognize as stages of secondary vegetation. On the whole, it is probable that the growth on the hills represents species of the original forest, although almost entirely secondary because of disturbances. The hills are too steep to be cultivated so that felling of the trees there has been restricted to species valuable for timber. Of course the hills have in the past as at present served as a source for fire-wood.

The forest on the hills is strikingly similar to that of similar habitats in Northern Petén. In fact I suspect that future explorations will show that the flora is practically the same with only local variations. Except for species of Loranthaceæ and Piperaceæ, practically all of the new species discovered in central Petén were found in the *rendzina* soil areas, and chiefly on the hills. These are undoubtedly

relics of the ancient forests. Botanically the hills are the most interesting areas of the savanna country, and future explorers visiting the area will find most novelties on them.

The narrow valleys between the limestone hills have soils of variable depth, yet the forest of these valleys may be considered to belong to a single major habitat type. At least the forest differs to a considerable degree from flatland high forest and the hill forest. It is characterized chiefly by giant leguminous trees. Fire destruction in the valleys is considerable. As far as I could determine, all the vegetation is secondary, which makes its classification difficult and untrustworthy, without long and critical study. Because of the disturbances, many successional stages are evident. The degree of endemism is not marked, in fact it is as small as in flatland high forest.

Whereas the forest on the hills shows many xerophytic characters, that of the least disturbed sectors of the valleys is quite mesophytic. A majority of the species are evergreen. The valley flora like that of the hills is quite similar to that of Northern Petén.

A detailed description of the habitats and the vegetation of each is given in the following section.

#### CLASSIFICATION OF THE VEGETATION

The vegetation of the phytogeographical division designated as the Central Petén Savanna Country (Plate 1) is entirely secondary. However, the vegetation of some areas may be considered to consist of sub-climax<sup>1</sup> and deflected climax types. The small areas (*aguadas* and swampy flatlands), which would support edaphic climax vegetation, are more or less disturbed. Fire destruction and man's activity have given rise to retrogressive stages in some instances.

The units of the savanna vegetation are described in the following order. Future detailed studies probably will make possible the recognition of other natural subdivisions not separated herein. (See Plate 26, in pocket inside back cover.)

##### I. Vegetation of deep flatland clays:

##### A. Vegetation of the open savannas (denuded flatlands):

1. Well-drained grasslands (*campos, nanzales, sahaales*).
2. Swampy grasslands (*bobolares*).
3. Inhabited areas (*pueblos, planteles, caminos*).

##### B. Vegetation associated with the sinkholes:

1. Drained sinkholes (*zúkches*).
2. Undrained sinkholes (*aguadas*).

##### C. Flatland forests and *milpa* clearings:

1. Marginal forests.
2. Flatland high forests (*zacuayumales, uapakales, corozales*).
3. *Milpas*.
4. Abandoned *milpas*.

<sup>1</sup>I use the term "sub-climax" to indicate a late secondary successional stage approaching the climax.

II. Vegetation of shallow calcareous soils (*rendzina*):

## A. Vegetation of the limestone hills, valleys, and mounds:

1. Hill caps (*pedregales*).
2. Hill slopes.
3. Limestone valleys (soil often deep).
4. Limestone mounds and deforested hills.

In the systematic lists of species collected in each habitat, the number of each collection is given, but not the locality. More than 90 per cent of all collections in the savanna country were made around La Libertad within a radius of about 7 kilometers. In the floral list for the entire savanna country, the general localities are given for every collection number (p. 156).

## VEGETATION OF THE OPEN SAVANNAS (DENUDED FLATLANDS)

## WELL-DRAINED GRASSLANDS

The greater part of the savanna country consists of grassy, open, broad, flat, well-drained clay plains (Plates 24 and 25). In general the vegetation of these is remarkably uniform.

The *campo*<sup>1</sup> is predominantly grassy with a growth scarcely exceeding one meter in height, and often averaging much less. The grasses are chiefly hardy perennials with deeply buried roots, corms, and stolons. They burn to the ground during the dry season, but sprout vigorously after each fire and at the beginning of the rainy season. Grasslands are favored by deep soils and a severe dry season followed by a wet vegetative period, conditions which exist in the savanna country.

The prominent grasses during the dry season are *Trachypogon angustifolius*, *Leptocoryphium lanatum*, *Axonopus purpusii*, *Andropogon condensatus*, *A. leucostachyus*, *A. glomeratus*, *Paspalum plicatulum*, and *P. langei*. A number of other grasses are common in the rainy season as evidenced by Aguilar's collections (see systematic list which follows).

After the early fires swept the Sabana San Francisco (fig. 1) in 1933, the short *Trachypogon montufari* sprouted, covering the area within a month, only to be burned a second time (see Plate 24). Smaller areas were similarly overgrown by *Leptocoryphium lanatum*. These two grasses are the dominants of the well-drained grasslands in the dry season.

Sheltered pockets between the hills, which had escaped the fires for several years, were densely covered with tall dry stems, dead leaves, and new green growth of species of *Andropogon*. Evidently *Andropogon* species, the largest of the commoner grasses, dominate extensive areas during the wet season.

Late in May and early in June 1933, when the rains arrived, *Axonopus purpusii* and species of *Panicum* and *Paspalum* grew rapidly, forming green mats through the *campo*, especially prominent along trails and sections most frequented by the cattle.

<sup>1</sup> *Campo* is the local Spanish term applied consistently to all open areas of the savanna country (Plates 24 and 25).

Although the grasses are dominant, they are greatly outnumbered in species by other herbs, chiefly perennials having large underground woody stems, corms, tubers, enlarged fleshy roots, and bulbs, adaptations to survive the extremes of the habitat. The fires destroy the above-ground vegetative parts, yet do not harm the buried storage structures.

When the first rains come in May, the herbs sprout out vigorously, making the savanna a luxuriant flower garden almost overnight. The red, blue, and yellow flowers of species of such genera as *Clitoria*, *Ruellia*, *Oxalis*, and *Phaseolus* conspicuously color the landscape, transforming the open black charred plains into places of exceeding beauty.

The genera of dicotyledons most abundantly represented are *Asclepias*, *Borreria*, *Buchnera*, *Cassia*, *Clitoria*, *Croton*, *Desmodium*, *Eriosema*, *Euphorbia*, *Evolvulus*, *Hyptis*, *Indigofera*, *Lantana*, *Mimosa*, *Oxalis*, *Phaseolus*, *Piriqueta*, *Polygala*, *Ruellia*, *Tephrosia*, *Turnera*, and *Zornia*. The legumes are especially common.

Monocotyledons, other than the grasses, become particularly conspicuous at the beginning of the wet season, although almost entirely absent during the dry period. Of these the sedges, *Cyperus globulosus*, *Dichromena ciliata*, and *Fimbristylis monostachya* are prominent locally. *Cipura paludosa*, *Curculigo scorzonrifolia*, *Hypoxis decumbens*, and three terrestrial orchids, *Stenorrhynchus orchoides*, *Bletia tuberosa*, and *Spiranthes aguacatensis*, are rather common the first weeks after the rains begin. From the collections of Aguilar it is evident that many other species make their appearance during the wet season.

Annuals may be common during the rainy months, but no studies have been made at that time to determine their importance. Collections of annuals and other herbs during the wet period might double the number of herbaceous species now known from the habitat.

As in savannas throughout the tropical world, scattered trees dot the landscape. The low gnarled *nanze*, *Byrsonima crassifolia*, and the shaggy-barked *saha*, *Curatella americana*, are two scrubby, fire-resistant xerophytes which characterize the well-drained grasslands of central Petén (Plates 24 and 27). When the *nanze* trees clump together in a small grove, the stand is called a *nanzal*. A grove of the *saha* trees is known locally as a *sahaal* (Plate 27, fig. 1).

The *cocoyol* palm, *Acrocomia mexicana* (Plate 28, fig. 2), grows in the *campo*, being even more conspicuous than the *nanze* and *saha* trees in some areas. Among the other trees standing solitary in the open grasslands, *Crescentia cujete* (Plate 29), *Ternstræmia tepezapote*, *Dipholis salicifolia*, *Hippocratea subintegra*, *Piscidia piscipula*, *Acacia angustissima*, and *Hæmatoxylum campechianum* are deserving of mention. The occurrence of *Hæmatoxylum campechianum*, the dominant species of the swampy *tintales* (pp. 27 to 29), in the habitat is of unusual interest, as its presence indicates edaphic conditions similar to those in the *akalches*.

Epiphytes, represented by species of *Tillandsia*, *Æchmea*, *Catopsis*, *Epiden-drum*, *Maxillaria*, and *Pleurothallis*, the aroid, *Philodendron lundellii*, and the fern,

*Polypodium palmeri*, may be mentioned as among the conspicuous elements of the vegetation. Although they are desiccated during the dry season, an unusual number of lichens, mosses, and liverworts are present. Steere (1934) has published an annotated list of the mosses I collected in the area.

Two crown parasites, *Phoradendron petenense* and *P. franciscanum*, both new species, were discovered on savanna trees.

In conclusion we note that the vegetation of the well-drained grasslands is represented by four major types, each adapted to the critical period of drouth and fire. These are: (1) the annuals passing their vegetative cycle during the wet season, (2) the perennials with underground storage structures, (3) the xerophytic fire-resistant trees and shrubs, and (4) the xerophytic epiphytes.

The savannas probably have been in existence for at least 500 years, and under prevailing conditions they will continue to exist. Fire destruction, grazing, and man's activity will probably retard the encroachment of forest growth. The savannas are subject to invasion, and therefore their vegetation can not be considered as the climatic climax. However, as long as the conditions persist which have evidently been present for centuries, the herbaceous assemblage will dominate. The herbaceous assemblage may be considered as a deflected climax association (for a discussion of such associations see Godwin, 1929, and Marshall, 1934).

The systematic list which follows contains all of the species collected in the well-drained grasslands. The collection numbers are those of the writer, unless otherwise indicated.

#### TREES AND LARGE SHRUBS:

Palmæ	<i>Acrocomia mexicana</i> Karw. Cocoyol, Supa. 3205.
Leguminosæ	<i>Acacia angustissima</i> (Mill.) Kuntze. Aguilar 149.
	<i>Hæmatoxylum campechianum</i> L. Palo tinta. 3261.
	<i>Piscidia piscipula</i> (L.) Sarg. Habin. 2817.
Malpighiaceæ	<i>Byrsonima crassifolia</i> (L.) HBK. Chi, Nanze. 1648, 2573.
Hippocrateaceæ	<i>Hippocratea subintegra</i> Blake. Zipiche. 3062, 3209.
Dilleniaceæ	<i>Curatella americana</i> L. Saha. 1655; Aguilar 403.
Ternstroemiaceæ	<i>Ternstroemia tepezapote</i> Schl. & Cham. Panool, Chique, Roble. 2578A, 3541; Aguilar 30.
Sapotaceæ	<i>Dipholis salicifolia</i> (L.) A. DC. Zitzya. 3098.
Bignoniaceæ	<i>Crescentia cujete</i> L. Calabaza. 3279.

#### LOW SHRUBS:

Leguminosæ	<i>Mimosa albida</i> Humb. & Bonpl. Zarza. 2385, 2452, 2617; Aguilar 219.
Myrtaceæ	<i>Psidium molle</i> Bertol. 2280, 3367. Common shrub in immediate vicinity of La Libertad.

#### LIANAS:

Leguminosæ	<i>Dalbergia glabra</i> (Mill.) Standl. Kibix. 1656.
Rubiaceæ	<i>Morinda yucatanensis</i> Greenm. 3492.

#### HERBS:

Gramineæ	<i>Andropogon bicornis</i> L. Zacaton. Aguilar 268.
	<i>Andropogon condensatus</i> HBK. 2374.
	<i>Andropogon glomeratus</i> (Walt.) B. S. P. 2482.
	<i>Andropogon leucostachyus</i> HBK. 2396.
	<i>Axonopus purpusii</i> (Mez) Chase. 2302, 3639, 3678.
	<i>Eragrostis acutiflora</i> (HBK.) Nees. 3605.
	<i>Hyparrhenia rufa</i> (Nees) Stapf. Aguilar 240.



- Leptochloa filiformis* (Lam.) Beauv. Aguilar 411.  
*Leptocoryphium lanatum* (HBK.) Nees. Pehillo, Arrozillo. 2287, 2288, 2393, 3670.  
*Panicum laxum* Sw. Aguilar 45A.  
*Panicum pilosum* Sw. Aguilar 8.  
*Paspalum convexum* Humb. & Bonpl. Aguilar 317.  
*Paspalum langei* (Fourn.) Nash. 3640.  
*Paspalum plicatulum* Michx. Zacate remolillo. 2305, 3561; Aguilar 45.  
*Setaria geniculata* (Lam.) Beauv. Cola de gato. 2294; Aguilar 70.  
*Trachypogon angustifolius* (HBK.) Nees. Pajon. 2306, 2392, 2467.  
*Tricholæna rosea* Nees. Ilusion de seda. Aguilar 50.  
 Cyperaceæ  
*Cyperus dissitiflorus* Torr. Aguilar 77.  
*Cyperus divergens* HBK. Aguilar 6.  
*Cyperus globulosus* Aubl. 2486.  
*Dichromena ciliata* Vahl. Jonquillo. 2296; Aguilar 41.  
*Fimbristylis monostachya* (L.) Hassk. Pan caliente. 3643.  
*Rynchospora cyperoides* (Sw.) Mart. Aguilar 71.  
*Rynchospora* sp. Aguilar 72.  
*Stenophyllus hirtellus* (Schrad.) Standl. Zacatillo. Aguilar 43.  
 Liliaceæ  
*Echeandia parviflora* Baker. Aguilar 305. Perennial.  
 Amaryllidaceæ  
*Curculigo scorzonifolia* (Lam.) Baker. 3451, 3630; Aguilar 163. Perennial.  
*Hypoxis decumbens* L. 3715.  
 Iridaceæ  
*Cipura paludosa* Aubl. 2476, 3646; Aguilar 20. Bulbous perennial.  
 Marantaceæ  
*Maranta arundinacea* L. Aguilar 111.  
 Orchidaceæ  
*Bletia tuberosa* (L.) Ames. 2710. A bulbous terrestrial herb.  
*Habenaria odontopetala* Rehb. f. Aguilar 156.  
*Habenaria setifera* Lindl. Aguilar 208.  
*Spiranthes aguacatensis* Rehb. f. 3704. Small terrestrial with cluster of fleshy roots.  
*Stenorrhynchus orchioides* (Sw.) L. C. Rich. Azucena del campo. 2748, 3484, 3625, 3677; Aguilar 365. Terrestrial with cluster of fleshy roots.  
 Piperaceæ  
*Peperomia pellucida* (L.) HBK. Mazamorra. Aguilar 143. Terrestrial of moist shaded areas.  
 Papaveraceæ  
*Argemone mexicana* L. Cardosanto. Aguilar 399.  
 Leguminosæ  
*Cassia flexuosa* L. 1639, 2402, 3512, 3673, 3740. Perennial with woody underground stem.  
*Cassia hirsuta* L. Frijolin macho. Aguilar 421.  
*Cassia tagera* L. 2303, 3671. Perennial with woody underground stem.  
*Centrosema angustifolium* (HBK.) Benth. 2289, 3486, 3739; Aguilar 201, 202. Slender perennial vine.  
*Clitoria guianensis* (Aubl.) Benth. Yerba de Mayo. 2745, 3653. Perennial with woody underground stem.  
*Crotalaria pterocaula* Desv. 2377.  
*Desmodium axillare* (Sw.) DC. 3710. Perennial with woody underground stem.  
*Desmodium barbatum* (L.) Benth. & Oerst. Aguilar 84. Perennial with woody underground stem.  
*Desmodium cubense* Griseb. 2380, 2468, 3667. Perennial with woody underground stem.  
*Desmodium frutescens* (Jacq.) Shindler. 2311, 4872. Perennial with woody underground stem.  
*Eriosema diffusum* (HBK.) Don. Carrillo. 1640, 2282, 2378, 3490, 3738. Perennial with woody underground stem.  
*Eriosema pinetorum* Standl. 2293, 3669, 3734A. Perennial with woody underground stem.  
*Eriosema pulchellum* (HBK.) Don. 2291, 3697, 3734. Perennial with woody underground stem.  
*Indigofera lespedezioides* HBK. 2284, 2307; Aguilar 73. Perennial with woody underground stem.  
*Mimosa pudica* L. Sensitiva. Aguilar 343.

- Mimosa somnians* Humb. & Bonpl. *Dormilona*. 2308, 2388, 3744.  
Perennial with woody underground stem.
- Phaseolus gracilis* Poepp. *Frijolillo*, *Flor de reina*. 1638, 1641, 2281, 2290, 2312, 2383, 2391, 3664, 3668, 3741. Perennial with woody underground stem. These collections probably represent more than one species.
- Tephrosia littoralis* (L.) Pers. 2403, 2456, 2712, 2746, 3611, 3666, 3745.  
Perennial with woody underground stem.
- Zornia diphylla* (L.) Pers. 2394, 3665, 3742; Aguilar 5. Slender perennial with woody underground stem.
- Oxalidaceæ  
*Oxalis nexi* DC. 3663, 3714.
- Polygalaceæ  
*Oxalis yucatanensis* (Rose) Standl. 3615.  
*Polygala bryzoides* St. Hil. 3701; Aguilar 53.  
*Polygala consobrina* Blake. 3644, 3681.  
*Polygala longicaulis* HBK. 2309, 2485; Aguilar 74.  
*Polygala wrightii* Chod. (?). 3661.
- Euphorbiaceæ  
*Croton glandulosus* L. Aguilar 33.  
*Croton lobatus* L. Aguilar 68.  
*Croton repens* Schlecht. 2313, 2749, 3514, 3683, 4875. Perennial with woody underground stem.  
*Euphorbia brasiliensis* Lam. 2375, 2491, 3703, 4433.  
*Euphorbia densiflora* Klotzsch. 2132, 2461.  
*Euphorbia heterophylla* L. *Ixbubt*. Aguilar 350.  
*Euphorbia hirta* L. 2492.  
*Euphorbia hyssopifolia* L. 2145.  
*Phyllanthus carolinensis* Walt. Aguilar 61, 204.  
*Tragia* sp. 2487. Perennial with woody underground stem.
- Malvaceæ  
*Malachra radiata* L. *Borraja rustica*. Aguilar 167.  
*Malvastrum coromandelianum* (L.) Garcke. Aguilar 83.  
*Sida glutinosa* Commers. *Chichibe macho*. Aguilar 381.  
*Sida lindheimeri* Engelm. & Gray. 2750.  
*Sida linifolia* Juss. Aguilar 380.  
*Sida rhombifolia* L. *Chichibe*. Aguilar 169.
- Sterculiaceæ  
*Melochia hirsuta* Cav. *Malva*. 2301, 2389; Aguilar 172.
- Turneraceæ  
*Waltheria americana* L. Aguilar 206.  
*Piriqueta cistoides* (L.) Mey. 3364, 3642, 3712, 4871; Aguilar 110.  
*Turnera ulmifolia* L. *Maba cimarron*. 2451, 3511, 3711; Aguilar 23.  
Perennial with woody underground stem.
- Violaceæ  
*Hybanthus angustifolius* (HBK.) Standl. 3662, 3713.
- Passifloraceæ  
*Passiflora foetida hastata* (Bert.) Mast. *Tujo*. 3207. Slender vine.
- Lythraceæ  
*Cuphea carthagenensis* (Jacq.) Macbride. *Chichibe*. 3736.
- Melastomataceæ  
*Clidemia rubra* (Aubl.) Mart. *Uva*. Aguilar 269.  
*Pterolepis trichotoma* (Rottb.) Cogn. Aguilar 238.
- Asclepiadaceæ  
*Asclepias curassavica* L. 2283.  
*Asclepias glaucescens* HBK. 2178.  
*Asclepias longicornu* Benth. 3733.  
*Asclepias setosa* Benth. 2484, 3476, 3645.
- Convolvulaceæ  
*Evolvulus sericeus* Sw. 2297, 2382, 2386, 2747, 3654, 3675, 3676, 3680; Aguilar 44.
- Boraginaceæ  
*Cordia globosa* (Jacq.) HBK. Aguilar 171.  
*Heliotropium procumbens* Mill. *Rabillo*. Aguilar 48.
- Verbenaceæ  
*Lantana camara* L. 2292, 2384, 2473. Perennial with woody underground stem.  
*Lantana trifolia* L. *Oregano*. 3493; Aguilar 117. Perennial with woody underground stem.
- Labiatae  
*Hyptis conferta* Pohl var. *angustifolia* Bth. *Amor seco de campo*. 2279, 2568; Aguilar 88, 404.  
*Hyptis pectinata* (L.) Poit. *Salada*. Aguilar 393.  
*Hyptis suaveolens* (L.) Poit. Aguilar 85.  
*Marsypianthes chamædrys* (Vahl) Ktze. 3699.

- Ocimum micranthum* Willd. Albake, Albahaca. 3735.  
*Scutellaria* sp. 3614.
- Scrophulariaceæ  
*Bacopa procumbens* (Mill.) Greenm. 3641.  
*Buchnera lithospermifolia* HBK. 3743.  
*Buchnera pusilla* HBK. 2304, 2310, 2397, 2458.  
*Escobedia lævis* Cham. & Schl. Aguilar 75.  
*Scoparia dulcis* L. Mastuerzo. Aguilar 140.
- Acanthaceæ  
*Elytraria bromoides* (Erst. 2395, 2471, 3708.  
*Ruellia geminiflora* HBK. Violeta del campo. 2286, 3485, 3672.  
*Stenandrium guatemalense* Leonard. 3539, 3679, 3707.  
*Stenandrium subcordatum* Standl. Violetita. 2295.
- Rubiaceæ  
*Borreria lævis* (Lam.) Griseb. Palis. Aguilar 52, 98.  
*Borreria ocimoides* (Burm. f.) DC. 2483.  
*Borreria suaveolens* Mey. 2299, 2376; Aguilar 136.  
*Coccocypselum hirsutum* Bartl. Aguilar 135.  
*Hemidiodia ocimifolia* (Willd.) Schum. 3698.  
*Richardia scabra* L. 3705; Aguilar 57, 152.
- Cucurbitaceæ  
*Lagenaria leucantha* (Lam.) Rusby. Bux de campo. Aguilar 178.  
Herbaceous vine.
- Compositæ  
*Lagenaria siceraria* (Molina) Standl. 3943, 4267.  
*Ageratum corymbosum* Zuccag. var. *latifolium* (DC.) Robinson. 2387; Aguilar 15.  
*Brickellia oliganthes* (Less.) Gray. 2472. Perennial with woody underground stem.  
*Calea zacatechichi* Schlecht. 2488.  
*Chaptalia nutans* (L.) Polak. Valeriana. 2453, 3652, 3689, 3717; Aguilar 118.  
*Elephantopus hypomalacus* Blake (?). 3700.  
*Elephantopus mollis* HBK. 2285.  
*Erechtites hieracifolia* (L.) Raf. Aguilar 207.  
*Erigeron bonariensis* L. Fabaguillo. Aguilar 115.  
*Erigeron jamaicensis* L. 3709.  
*Eupatorium macrocephalum* Less. Macedon. Aguilar 113.  
*Melanthera angustifolia* A. Rich. 2490, 3651; Aguilar 4, 112. Perennial with woody underground stem.  
*Orthopappus angustifolius* (Sw.) Gleason. Aguilar 301.  
*Pectis elongata* HBK. Cominillo. Aguilar 170.  
*Tagetes schiedeana* Less. Pericon. Aguilar 58.  
*Tridax procumbens* L. 3280.
- EPIPHYTES:
- Bromeliaceæ  
*Catopsis berteroniana* (Schult. f.) Mez. 2909.  
*Tillandsia dasyliriifolia* Bak. 2552, 2643.  
*Tillandsia fasciculata* Sw. 2644.  
*Tillandsia festucoides* Brongn. 2449.  
*Tillandsia polystachya* L. 2607.  
*Tillandsia schiedeana* Steud. 2517.
- Orchidaceæ  
*Epidendrum aciculare* Batem. 2711.  
*Maxillaria uncata* Lindl. 2324.  
*Polystachya* sp. 2144, 2381, 2428.
- WOODY CROWN PARASITES:
- Loranthaceæ  
*Phoradendron franciscanum* Trel. Mata palo. 2398, 3834; Aguilar 12.  
*Phoradendron petenense* Trel. 2400.

SWAMPY GRASSLANDS (*Bobolares*)

Low swampy areas of the clay plains, known locally as *bobolares*, have the characteristic tussock formation of poorly drained lands. One of the largest

*bobolares* covers the northern half of Sabana Zotz (Plate 30), other smaller ones were found in Sabana Polol and Sabana Chicha (fig. 1).

Grasses and sedges are the most prominent constituents of the vegetation. Among the grasses may be mentioned *Trachypogon angustifolius*, *Andropogon selloanus*, *Paspalum pulchellum*, *Axonopus purpusii*, and the arrozillo, *Leptocoryphium lanatum*. Although grasses may be considered dominant, the sedges are more prominent than in drained areas. *Rynchospora aristata*, *R. globosa*, and *Scleria hirtella* were collected in the *bobolar* of Sabana Zotz.

In the same area, *Croton repens* and *Ruellia geminiflora* grew on top of the tussocks. *Melochia hirsuta* and *Wedelia parviceps*, two species typical of wet or swampy areas, were among the components of the association.

The characteristic plant of the *bobolares* is the *lirio zac*, *Hymenocallis littoralis* (Plate 30).

The herbs given in the following list comprise the dry season collections in the swampy grasslands of central Petén. Trees and shrubs are very rare in the habitat. The collection numbers are those of the writer, unless otherwise indicated.

#### PERENNIAL HERBS:

Gramineæ	<i>Andropogon selloanus</i> (Hack.) Hack. 3596. <i>Axonopus purpusii</i> (Mez) Chase. 3594. <i>Leptocoryphium lanatum</i> (HBK.) Nees. Arrozillo. 3597. <i>Paspalum pulchellum</i> Kunth. 3583. <i>Trachypogon angustifolius</i> (HBK.) Nees. 3595.
Cyperaceæ	<i>Cyperus luzulæ</i> (L.) Retz. Aguilar 9. <i>Fimbristylis miliacea</i> (L.) Vahl. Aguilar 182. <i>Rynchospora aristata</i> Boeckl. 3599. <i>Rynchospora globosa</i> (HBK.) R. & S. 3598. <i>Scleria hirtella</i> Sw. 3593; Aguilar 109. <i>Scleria secans</i> (L.) Urban. Zacate de huecht. Aguilar 308.
Amaryllidacææ	<i>Hymenocallis littoralis</i> (Jacq.) Salisb. Lirio zac. 3622.
Euphorbiaceæ	<i>Croton repens</i> Schlecht. 3624.
Sterculiaceæ	<i>Melochia hirsuta</i> Cav. 3582.
Acanthaceæ	<i>Ruellia geminiflora</i> HBK. 3581.
Compositæ	<i>Wedelia parviceps</i> Blake. 3623.

#### INHABITED AREAS

In the savanna country of central Petén all of the villages are located in the *campo* near *aguadas*. The savannas are reputed to be largely free from mosquitoes and flies, therefore more desirable than forested areas for village sites.

My collections and studies in inhabited areas were confined to the villages of La Libertad and Chiche, and the Polol settlement. About 95 per cent of the collections were made within the confines of the village of La Libertad (Plate 31).

La Libertad lies in the *campo* known to the older Maya as Zacluk, the name applied formerly to the village itself. The study of the plants growing within the village revealed an astonishing assortment of introduced and native species. In the house enclosures with their gardens and orchards, along the fence rows, through the streets, and around the *aguada* I found a motley variety of plant growth.

Fruit trees such as the mango, *mamey de Santo Domingo*, *caimito*, *mamey*, *guayo*, *siricote*, *marañon*, *aguacate*, breadfruit, and the coconut palm reach a greater size than I have observed elsewhere in the Maya area (Plate 31). A pine tree introduced from Poctun is estimated to be 30 meters in height.

Planted *ramon* trees thrive, growing as luxuriantly as in the limy Northern Petén country. If the village ever should be abandoned, the *ramon* might well gain a position of dominance giving a *ramonal*. Savanna *ramonales* are said to exist in the eastern savannas of central Petén, areas not visited by the writer.

Perusal of the species given in the systematic list which follows will reveal the wealth of useful plants found within the villages. A total of 243 species, listed below, were collected, and at least 30 per cent of these are important as food and medicinal plants. Ornamentals make up 25 per cent of the total, which gives an idea of the attention the people give to flowers. Many plants which appear to be useless weeds to the casual observer are in reality medicinal herbs introduced by the natives. These often thrive as escapes. I estimate that less than 20 per cent of the plants found in the villages should be classed as non-economic. The collection numbers are those of the writer, unless otherwise indicated.

Polypodiaceæ	<i>Adiantum tenerum</i> Sw. Culantrillo. Aguilar 120.
	<i>Nephrolepis biserrata</i> (Sw.) Schott. 2952.
	<i>Nephrolepis pendula</i> (Raddi) J. Sm. 2915.
	<i>Polypodium astrolepis</i> Liebm. 2444.
	<i>Polypodium triseriale</i> Sw. 2951.
Pinaceæ	<i>Polypodium polypodioides</i> (L.) Watt. 2494, 3403.
	<i>Cupressus benthami</i> Endl. Cypres. 3244.
	<i>Pinus caribæa</i> Morelet. Pino. 2846.
Gramineæ	<i>Bambusa vulgaris</i> Schrad. 2647.
	<i>Cymbopogon citratus</i> (DC.) Stapf. Te de limon. Aguilar 42.
	<i>Cynodon dactylon</i> (L.) Pers. Aguilar 66.
	<i>Dactyloctenium ægyptium</i> (L.) Richt. Aguilar 191, 205.
	<i>Digitaria sanguinalis</i> (L.) Scop. Aguilar 191A.
	<i>Eleusine indica</i> (L.) Gaertn. Aguilar 65.
	<i>Eragrostis ciliaris</i> (L.) R. Br. 2641; Aguilar 346.
	<i>Leptochloa filiformis</i> (Lam.) Beauv. Aguilar 203.
	<i>Oryza sativa</i> L. Arroz. 3601.
	<i>Paspalum conjugatum</i> Berg. Aguilar 141, 191B.
	<i>Paspalum langei</i> (Fourn.) Nash. 3608, 3857.
	<i>Sorghum vulgare</i> Pers. Maicillo. Aguilar 35, 90.
Palmæ	<i>Zea mays</i> L. Maiz.
	<i>Cocos nucifera</i> L. Coco. 3215.
Bromeliaceæ	<i>Sabal mexicana</i> Mart. Bonxaan, Huano de sombrero. 3073.
	<i>Æchmea bracteata</i> (Sw.) Griseb. Ixchu, Tinajero. 2549, 2828.
	<i>Ananas comosus</i> (L.) Merrill. Piña. 3214.
	<i>Bromelia karatas</i> L. Piñuela.
	<i>Tillandsia balbisiana</i> Schult. f. 2913.
	<i>Tillandsia brachycaulos</i> Schdl. 2908, 3753.
	<i>Tillandsia dasyliriifolia</i> Baker. 2912.
	<i>Tillandsia fasciculata</i> Sw. 2914.
	<i>Tillandsia festucoides</i> Brongn. 2907.
	<i>Tillandsia polystachya</i> L. 2163, 2910.
Araceæ	<i>Tillandsia pruinosa</i> Sw. 2911.
	<i>Syngonium podophyllum</i> Schott. 2432, 3522.
Commelinaceæ	<i>Commelina elegans</i> HBK. Lil. 3694.

- Liliaceæ *Asparagus plumosus* Baker. *Vela de novia*. 2372.  
*Yucca elephantipes* Regel. *Palmera*. 2531.
- Dioscoreaceæ *Dioscorea alata* L. *Macal*.  
*Dioscorea bulbifera* L. *Papa voladora*. Aguilar 221, 223.
- Amaryllidaceæ *Agave sisalana* Perrine. *Heneguen*. 3528.  
*Hippeastrum puniceum* (Lam.) Urban. *Lirio*. 2413.  
*Zephyranthes citrina* Baker. *Hacinto*. 2162, 3350.
- Musaceæ *Musa paradisiaca* L. *Platano*.  
*Musa sapientium* L. 3061.
- Cannaceæ *Canna edulis* Ker. *Platanillo*. Aguilar 391.
- Marantaceæ *Calathea lutea* (Aubl.) Mey. *Moxan*. 2419.
- Orchidaceæ *Campylocentrum micranthum* Rolfe. 2164.  
*Epidendrum aciculare* Batem. 2274.  
*Epidendrum rigidum* Jacq. 3526.  
*Maxillaria friedrichsthali* Rehb. f. 2367.  
*Notylia trisepala* Lindl. & Paxt. 2146, 2275.  
*Oncidium ascendens* Lindl. 2165, 2277.  
*Pleurothallis purpusii* Schltr. 3893.  
*Trigonidium egertonianum* Batem. 2278.
- Piperaceæ *Piper* sp. 3524.  
*Piper* sp. 2808.  
*Peperomia polochicana* Trel. 3045.
- Moraceæ *Artocarpus communis* Forst. *Castaña*. 3385.  
*Brosimum alicastrum* Sw. *Ramon*. 3256, 3515.  
*Castilla elastica* Cerv. *Hule*. 2156, 3349.  
*Ficus ærstediana* Miq. *Copo*. 3706.  
*Ficus radula* Willd. *Chimon*. 2426.  
*Ficus tuerckheimii* Standl. *Copo*. 3253.
- Urticaceæ *Laportea mexicana* (Liebm.) Miq. *Laal, Ortiga*. 3104.
- Loranthaceæ *Phoradendron zacapanum* Trel. 2819.  
*Struthanthus orbicularis* (HBK.) Blume. 3529; Aguilar 358.
- Aristolochiaceæ *Aristolochia odoratissima* L. *Wako, Patito*. 2318.
- Polygonaceæ *Antigonon leptopus* Hook. & Arn. *San Diego*. 2809.
- Amaranthaceæ *Achyranthes indica* (L.) Mill. *Mozotlexc*. Aguilar 401.  
*Alternanthera repens* (L.) Kuntze. *Sanguinaria*. Aguilar 376.  
*Amaranthus spinosus* L. *Ixtez*. 2172, 3033.  
*Celosia cristata* L. 2412.  
*Gomphrena globosa* L. *Amor seco*. Aguilar 361.  
*Iresine celosia* L. Aguilar 93.
- Nyctaginaceæ *Berhaavia coccinea* Mill. *Ericipela*. Aguilar 151.  
*Bougainvillea glabra* Choisy. *Bogambilla*. 2369, 2371.  
*Neea psychotrioides* Donn. Sm. 2418.
- Portulacaceæ *Talinum paniculatum* (Jacq.) Gaertn. Aguilar 364.
- Caryophyllaceæ *Dianthus chinensis* L. *Clavel roja*. 2983.  
*Drymaria cordata* (L.) Willd. Aguilar 193.
- Annonaceæ *Annona muricata* L. *Guanabana*. 2373.  
*Annona squamosa* L. *Chirimoya, Zaramuya*. 2800; Aguilar 122.
- Lauraceæ *Nectandra sanguinea* Rottb. (?). *Laurel*. 2176, 2219.  
*Persea americana* Mill. *On, Aguacate*. 2798; Aguilar 397.
- Papaveraceæ *Argemone mexicana* L. *Cardosanto*. 2155.
- Capparidaceæ *Gynandropsis speciosa* (HBK.) DC. *Alcachofla*. 2414; Aguilar 34, 416.
- Cruciferae *Brassica juncea* (L.) Coss. *Mostaza, Colinabo*.  
*Lepidium virginicum* L. *Mastuerzo*. Aguilar 60.
- Moringaceæ *Moringa oleifera* Lam. *Paraíso blanco*. 2404.
- Rosaceæ *Couepia dodecandra* (DC.) Hemsl. *Uspip, Zuspi*. 3267, 3719, 4881; Aguilar 36.  
*Rosa indica* L. *Hechisa*. Aguilar 108.
- Leguminosæ *Bauhinia divaricata* L. 3277.  
*Cæsalpinia pulcherrima* (L.) Sw. *Zinkin, Cabello de angel*. 2407.  
*Cajanus bicolor* DC. *Chicharo*. 2317, 3386; Aguilar 95.  
*Calliandra* sp. *Tukuy, Mota*. 2904.  
*Cassia grandis* L. f. 2427.

- Cassia occidentalis* L. Frijolillo. 2166; Aguilar 200.  
*Centrosema virginianum* (L.) Benth. 2431.  
*Cltoria ternatea* L. Concha blanca. 3731.  
*Crotalaria maypurensis* HBK. Chipilin. Aguilar 32.  
*Desmodium frutescens* (Jacq.) Schindler. 3530.  
*Erythrina rubrinervia* HBK. Pito. 2446.  
*Gliricidia sepium* (Jacq.) Steud. Kante, Madre de cacao. 2179, 2420.  
*Indigofera suffruticosa* Mill. 2320.  
*Inga paterno* Harms. Paterna. Aguilar 377.  
*Rhynchosia pyramidalis* (Lam.) Urban. 4420.  
*Tamarindus indica* L. Tamarindo. 2795, 3303.  
*Kallstræmia maxima* (L.) Torr. & Gray. Aguilar 175.  
*Citrus aurantifolia* (Christm.) Swingle. Limon paa. 3069.  
*Citrus aurantium* L. Naranja agria.  
*Citrus sinensis* Osbeck. Naranja de China.  
*Murraya paniculata* (L.) Jack. Limonaria. 3557; Aguilar 333.  
*Cedrela mexicana* Roem. Kuche. 3060.  
*Melia azedarach* L. Paraíso. 2181; Aguilar 315.  
*Trichilia hirta* L. Cedrillo. 2548.  
*Banisteria laurifolia* L. Pomposa. 4880.  
*Acalypha arvensis* Poepp. & Endl. Corrimiento. Aguilar 105.  
*Acalypha setosa* A. Rich. Aguilar 157.  
*Acalypha wilkesiana* Muell. Arg. Paslor. 2796.  
*Alchornea latifolia* Sw. 2829.  
*Codiaeum variegatum* (L.) Blume. 2368.  
*Euphorbia hirta* L. Aguilar 176.  
*Euphorbia pulcherrima* Willd. Hoja de pascua. 2316; Aguilar 389.  
*Jatropha curcas* L. Piñon. 3695.  
*Manihot esculenta* Crantz. Yuca. 3763.  
*Anacardium occidentale* L. Marañon. 2409, 2801.  
*Mangifera indica* L. Mango. 2804.  
*Spondias purpurea* L. Jobo. 2797, 3283.  
*Talisia olivæformis* Radlk. Kenep, Guayo. 2985; Aguilar 373.  
*Impatiens balsamina* L. Chinas. 2410.  
*Corchorus orinocensis* HBK. Malva rustica. Aguilar 196.  
*Triumfetta semitriloba* Jacq. Mozote de caballo. Aguilar 188.  
*Abutilon hirtum* (Lam.) Sweet. 3439.  
*Anoda cristata* (L.) Schlecht. Aguilar 31.  
*Hibiscus esculentus* L. 2953.  
*Hibiscus mutabilis* L. Amistad. Aguilar 142.  
*Hibiscus rosa-sinensis* L. Clavel. 2159, 2315.  
*Hibiscus schizopetalus* (Mart.) Hook. Tulipan. 2161.  
*Malachra fasciata* Jacq. Malva rustica. Aguilar 412.  
*Pavonia rosea* Schlecht. Mozote, Kadillo. 2820; Aguilar 158.  
*Bombax ellipticum* HBK. Amapola, Chulte colorado. Aguilar 366.  
*Guazuma ulmifolia* Lam. Pixoy. 3231.  
*Sterculia apetala* (Jacq.) Karst. Bellota. 3254.  
*Theobroma cacao* L. Cacao. 2799.  
*Mammea americana* L. Mamey. 3269.  
*Bixa orellana* L. Achiote, Pochote. 2441, 3255, 4434.  
*Cochlospermum vitifolium* (Willd.) Spreng. Pochote. 2434.  
*Hybanthus longipes* (Dowell) Standl. Aguilar 56.  
*Casearia aculeata* Jacq. 3368.  
*Passiflora biflora* Lam. 3400.  
*Begonia martiana* Link & Otto (?). 2982.  
*Begonia nicaraguensis* Standl. Aguilar 418.  
*Cereus grandiflorus* (L.) Mill. 3513.  
*Cereus hexagonus* (L.) Mill. (?). 3572.  
*Lagerstræmia indica* L. Jupiter. 2405.  
*Lawsonia inermis* L. Ricidron. Aguilar 76.



- Punicaceæ *Punica granatum* L. Granado. 3401; Aguilar 352.  
 Combretaceæ *Combretum farinosum* HBK. 2433.  
*Terminalia catappa* L. Almendro. 3268.  
 Myrtaceæ *Eugenia jambos* L. Manzana rosa, Pomarroza. 2821; Aguilar 101.  
*Pimenta officinalis* Lindl. 3402, 4278.  
*Psidium guajava* L. Guayabo. 2596.  
 Umbelliferæ *Eryngium foetidum* L. Silantro cimarron. Aguilar 131.  
 Sapotaceæ *Achras zapota* L. Ya, Chicozapote, Zapote. 2805.  
*Calocarpum mammosum* (L.) Pierre. Mamey. 2826.  
*Chrysophyllum cainito* L. Caimito. 2496; Aguilar 154.  
*Lucuma hypoglauca* Standl. Mamey de Santo Domingo. 3265; Aguilar 81.  
 Oleaceæ *Jasminum grandiflorum* L. Jazmin. 2806.  
*Jasminum pubescens* (Retz.) Willd. Jazmin de novia. 2802; Aguilar 155.  
*Jasminum sambac* (L.) Ait. Jazmin de Amelia. Aguilar 82.  
 Apocynaceæ *Catharanthus roseus* (L.) Don. Chula, Lila. 2807.  
*Mesechites trifida* (Jacq.) Muell. Arg. 2276.  
*Nerium oleander* L. Narciso. 2803; Aguilar 137.  
*Plumeria acutifolia* Poir. Matuhua, Flor de Mayo. 2810, 2811.  
*Plumeria rubra* L. Nicté chachac, Flor de Mayo. 2822, 3023.  
*Rauwolfia canescens* L. 2493, 3399; Aguilar 138.  
*Stemmadenia galeottiana* (A. Rich.) Miers. Ixlao. 2406, 3559.  
*Thevetia ahouai* A. DC. Cojon de perro. 2421.  
*Thevetia peruviana* (Pers.) K. Sch. Acitz. 3266; Aguilar 130.  
 Asclepiadaceæ *Asclepias curassavica* L. 2108, 3696.  
 Convolvulaceæ *Calonyction aculeatum* (L.) House. Luna blanca. Aguilar 330.  
*Evolvulus nummularius* L. Aguilar 174.  
*Merremia umbellata* (L.) Hallier. 2445.  
 Hydrophyllaceæ *Nama jamaicense* L. 3414.  
 Boraginaceæ *Cordia dodecandra* DC. Kopte, Siricote. 2896.  
*Heliotropium indicum* L. Chamico. 2168.  
 Verbenaceæ *Bouchea prismatica* (L.) Kuntze. Verbena. 2171.  
*Callicarpa acuminata* HBK. 3755.  
*Clerodendron fragrans* Vent. Jazmin de España. 2408.  
*Lippia alba* (Mill.) N. E. Brown. Oregano. Aguilar 40.  
*Lippia dulcis* Trev. Malba, Orozus. 2180, 3537, 3688.  
*Priva lappulacea* (L.) Pers. 3693.  
*Stachytarpheta cayennensis* (L. Rich.) Vahl. Verbena. Aguilar 69.  
 Labiatae *Coleus blumei* Benth. Hoja de color. 2167.  
*Hyptis verticillata* Jacq. Yerba Martin. 2173, 3525.  
*Leonotis nepetæfolia* (L.) R. Br. 2174; Aguilar 139.  
*Ocimum micranthum* Willd. Albake, Albahaca. 2370; Aguilar 103, 145.  
*Salvia coccinea* L. var. *pseudococcinea* Gray. 3756; Aguilar 106.  
*Salvia riparia* Kunth. Aguilar 298.  
 Solanaceæ *Brunfelsia nitida* Benth. Gallan. 2417.  
*Capsicum annuum* L. Chile grande. Aguilar 78.  
*Capsicum baccatum* L. Aguilar 177.  
*Capsicum frutescens* L. Chile largo, Picante, Chile pico de paloma. Aguilar 64, 199.  
*Capsicum petenense* Standl. Chile dulce. 3754.  
*Datura candida* (Pers.) Pasq. Campana. 3729.  
*Lycopersicum esculentum* Mill. Tomate.  
*Nicotiana tabacum* L. 3328.  
*Physalis pubescens* L. Tomatillo. Aguilar 51.  
*Solanum aculeatissimum* Jacq. Berenjena. 3032.  
*Solanum diversifolium* Schlecht. Baxbalum, Berenjena. 2175.  
*Solanum hirtum* Vahl. 2177, 3998.  
*Solanum mammosum* L. Chuchou, Berenjena. 3031.  
*Solanum seforthianum* Andr. Lagrima de la Virgin. 2411.  
*Solanum wendlandii* Hook. f. 2751, 2984.

Scrophulariaceæ	<i>Capraria biflora</i> L. <i>Esclaviosa</i> . Aguilar 123. <i>Stemodia verticillata</i> (Mill.) Hassler. 3415.
Martyniaceæ	<i>Martynia annua</i> L. <i>Uña de gato</i> . Aguilar 144.
Bignoniaceæ	<i>Crescentia cujete</i> L. <i>Calabaza</i> . 2325. <i>Tabebuia pentaphylla</i> (L.) Hemsl. <i>Makalis</i> . 3282.
Acanthaceæ	<i>Blechum pyramidatum</i> (Lam.) Urban. <i>Corrimiento</i> . 2170; Aguilar 192. <i>Jacobinia spicigera</i> (Schl.) L. H. Bailey. <i>Añil</i> . 2415. <i>Jacobinia umbrosa</i> (Benth.) Blake. <i>Pot de cambul</i> . 2864. <i>Thunbergia fragrans</i> Roxb. <i>Mariquita</i> . Aguilar 375.
Plantaginaceæ	<i>Plantago major</i> L. <i>Llanten</i> . Aguilar 407.
Rubiaceæ	<i>Borreria ocimoides</i> (Burm.) DC. <i>Palitaria</i> . Aguilar 195. <i>Coffea arabica</i> L. <i>Cafe</i> . 2322; Aguilar 359, 360. <i>Hamelia patens</i> Jacq. Aguilar 10, 39.
Caprifoliaceæ	<i>Sambucus mexicana</i> Presl. <i>Sanco</i> . 2416.
Cucurbitaceæ	<i>Cayaponia racemosa</i> (Sw.) Cogn. 2516. <i>Cucurbita moschata</i> Duch. <i>Kuum</i> , <i>Calabaza</i> . 2981, 4268. <i>Cucurbita radicans</i> Naud. <i>Bulot</i> . 3558.
Lobeliaceæ	<i>Isotoma longiflora</i> (L.) Presl. <i>Ilusion</i> . 2642.
Compositæ	<i>Artemisia mexicana</i> Willd. <i>Inciense</i> . Aguilar 67. <i>Brickellia diffusa</i> (Vahl) Gray. <i>Visquita</i> . Aguilar 414. <i>Erigeron bonariensis</i> L. <i>Artemisa</i> . 4876. <i>Eupatorium macrophyllum</i> L. Aguilar 18. <i>Parthenium hysterophorus</i> L. 3730. <i>Pseudelephantopus spicatus</i> (Juss.) Rohr. <i>Codillo</i> , <i>Lengua de vaca</i> . 2169, 3042; Aguilar 186. <i>Senecio confusus</i> Britten. Aguilar 121. <i>Spilanthes americana</i> (Mutis) Hieron. Aguilar 413. <i>Synedrella nodiflora</i> (L.) Gaertn. Aguilar 410. <i>Tagetes erecta</i> L. <i>Ixtupug</i> , <i>Sanpuel</i> . Aguilar 150. <i>Trixis radialis</i> (L.) Kuntze. 2422, 3028.

## VEGETATION ASSOCIATED WITH THE SINKHOLES

The Petén savanna flatlands are dotted throughout with wooded areas, in appearance not unlike islands, ranging in size from small brambly clumps of vegetation to sections of forest covering several square miles (Plates 25, 32, and 35). The nuclei around which these have developed are, in most instances, the drained and undrained sinkholes.

The sinkholes with underground outlets hold water for relatively short periods. Trees grow in their basins and around their margins. The undrained sinkholes, called *aguadas* (Plates 33 and 34), hold water more or less permanently, and have a vegetation influenced by the abundance of water.

DRAINED SINKHOLES (*Zukches*<sup>1</sup>)

Although no native term is applied generally to the wooded islands, the Maya sometimes call the smaller one *zukches*. The islands of considerable size, with *aguadas* in them, often are given individual names such as Aguada Copo, Aguada Yaxnic (in Monte Chicbul), Aguada Chachacluum, Aguada Chicah, Aguada San Francisco, Aguada Chimah Pequeño, etc. However, the smaller wooded areas (Plates 25 and 32, fig. 2), to be called *zukches* hereafter, seldom are known by place names.

<sup>1</sup> Spelled *zutche* by Aguilar.

Almost all of the *zúkches* have drained sinkholes within them. These sinkholes are, as a rule, small shallow basins not exceeding 2 meters in depth. Evidently the break in the substratum increases the accessibility of the ground water, thereby favoring trees and other woody vegetation. The fact that much of the *campo* drainage is through sinkholes probably results in seepage through them of dissolved fertilizer salts washed from the fire-swept areas. The drained sinkholes are invariably overgrown.

In order to obtain an adequate record of the vegetation composing these *zúkches*, the bush of one of them was thoroughly analyzed. Every species was collected or noted.

The small *zúkche* chosen for the study lies in the Sabana Chicha about 2 km. south of La Libertad (fig. 1). It is somewhat oval in shape, with a maximum diameter not exceeding 25 meters. In its center is a shallow sink about 5 meters wide and not more than one meter deep. A view of the island before clearing began is given in Plate 32, figure 2.

The study was made on March 30 and 31, 1933, before fires had swept through the area. Most of the trees, shrubs, and vines still retained their leaves, and many were in flower and fruit. The herbaceous growth had dried up almost completely, which accounts for the small representation of such species.

The *zúkche* is relatively small, yet its vegetation shows definite zonation, an outer thorn-scrub belt, and an inner area more complex and taller corresponding to the intermediate belt of the marginal forest (p. 135).

The narrow thorn-scrub belt surrounding the island was dominated by the *pasita*, *Conostegia xalapensis*, with the thorny *subin*, *Acacia spadicigera*, the *limoncillo*, *Erythroxylon areolatum*, the *chilonche*, *Eugenia capuli*, *Schæpfia schreberi*, *Xylosma hemsleyana* (?), and *Vernonia aschenborniana* as shrubby associates. Two lianas, the *bejuco de cachicon*, *Tetracera volubilis*, and *Davilla kunthii* were prominent, the former covering the crown of *Curatella americana*. On the floor in the same zone, two small shrubs, *Mimosa albida* and *Randia aculeata*, two herbs, *Sida acuta* and *Elephantopus mollis*, and a covering of dry unrecognized savanna grasses formed a low dense growth.

Proceeding inward through the outer thorn-scrub belt, which scarcely exceeded two meters in width, the central zone was entered. Here the tall slender *capulincillo*, *Xylopia frutescens*, the *flor de pasar*, *Simaruba glauca*, a tree 8 meters high and 40 cm. in diameter, the *cocoyol* palm, *Acrocomia mexicana*, and the *saha*, *Curatella americana*, were dominant trees (Plate 32, fig. 2).

Tall juvenile trees included the *jobo*, *Spondias mombin*, the *cojon de caballo*, *Tabernæmontana chrysocarpa*, the *tamay*, *Zuelania guidonia*, *Cupania glabra*, *Trichilia hirta*, and *T. trifolia*. The central zone contained an unusual number of tall shrubs, among which were the *pullun*, *Casearia aculeata*, the *ceniciente*, *Calli-carpa acuminata*, the *tulipan*, *Malvaviscus brevibracteatus*, *Allophylus cominia*, *Ardisia compressa* (?), and *Cornutia pyramidata* var. *isthmica*. Two small shrubs, *Psychotria sessilifolia* and *Lycianthes variifolia*, are deserving of mention.

Intertwined among these were woody and suffrutescent vines, the *bejuco colorado*, *Cnestidium rufescens*, the *diente de perro*, *Smilax spinosa*, *Chiococca alba*, and *Serjania atrolineata*. Slender suffrutescent vines included *Rhynchosia pyramidalis*, *Mandevilla subsagittata*, *Centrosema virginianum*, *Passiflora biflora*, *P. coriacea*, and the *tujo*, *P. fætida lanuginosa*. Two scramblers, *Lasiacis divaricata* and *Eupatorium odoratum*, were present.

The entire floor of the interior of the island, including the sinkhole basin, was overrun with *Oplismenus hirtellus*. In addition there were a few plants of *Lithachne pauciflora* as well as a small undeterminable sedge, apparently a species of *Scleria*.

The trunks of the *cocoyol* palms were overgrown by the epiphytic fern, *Nephrolepis pendula* (?). As shown in Plate 32, figure 2, a hemi-epiphyte, *Ficus cookii* (?), had become established on one of the palms. The fig may eventually grow into a tree and dominate the island, for giant fig trees are characteristic of many of these *zukches*.

On the branches of the large *Simaruba glauca*, I collected no less than six species of small xerophytic orchids, *Pleurothallis comayaguensis*, *P. marginata*, *Scaphyglottis livida*, *Epidendrum stenopetalum*, *Jacquiniella globosa*, and *Oncidium ascendens*.

The mosses, liverworts, lichens, and fungi from the same island will be listed in publications on the cryptogams.

The vegetation of this *zukse* is typical, in general aspects, of that encountered in others of similar size. However, this similarity does not imply that all have the same specific composition.

The vegetation of the vanguard thorn-scrub belt of the *zukches* is the same as that of the thorn-scrub belt of the marginal forest (p. 135). Dominance varies from island to island, but the same species are characteristic.

Specific composition of the central section of the *zukches* is variable. The study of the afore-mentioned island (Plate 32, fig. 2) revealed *Xylopia frutescens*, *Simaruba glauca*, and *Acrocomia mexicana* as the dominants there. In other small wooded areas of the flatlands, these three species may be entirely absent, as shown in Plate 28, figure 1, where *Miconia argentea* and *Bursera simaruba* dominate. In addition, trees such as the following may characterize the interior of islands individually or jointly: *Metopium brownei*, *Matayba oppositifolia*, *Ficus involuta*, *Didymopanax morototoni*, *Coussapoa oligocephala*, *Piscidia piscipula*, *Pithecolobium leucocalyx*, *Randia albonervia*, *Spondias mombin*, *Cochlospermum vitifolium*, *Coccoloba schiedeana*, *Nectandra sanguinea* (?), and *Cecropia* spp. These trees are the same species encountered in the intermediate and transitional belts of the marginal forest (p. 135).

A few small clumps of trees are encountered in the open *campo* where no surface indications of sinks exist. In these tree groups *Acrocomia mexicana* is generally outstanding. A small clump with a species of *Ficus* is shown in Plate 32, figure 1.

When the wooded islands exceed 50 meters in diameter, the vegetation of their central areas tends to be mesoxerophytic and mesophytic. Drained sink-holes exist in them, yet the influence of these sinkholes on the vegetation is, comparatively speaking, not so pronounced. The larger wooded areas of the deep clay flatlands, some containing high sub-climax forest, are discussed in detail under the savanna forest (pp. 121 and 141).

The 59 species collected in the *zucche* shown in Plate 32, figure 2, are given in the following list. Note the number of juveniles of large trees whose invasion is part of one phase of the succession which will lead eventually to establishment of mesophytic conditions as the island increases in size. The collection numbers are those of the writer.

## TREES:

- |               |   |
|---------------|---|
| Palmæ         | <i>Acrocomia mexicana</i> Karw. <i>Cocoyol</i> , <i>Supa</i> . 3205.                      |
| Annonaceæ     | <i>Xylopia frutescens</i> Aubl. <i>Capulincillo</i> . 2243, 2341.                         |
| Lauraceæ      | <i>Phœbe mexicana</i> Meissn. (?). <i>Aguacatillo</i> . 2346. Juvenile.                   |
| Meliaceæ      | <i>Trichilia hirta</i> L. 2261. Juvenile.   |
|               | <i>Trichilia trifolia</i> L. 2335. Juvenile.  |
| Simarubaceæ   | <i>Simaruba glauca</i> DC. <i>Flor de pasar</i> , <i>Zapatero</i> . 2234.                 |
| Burseraceæ    | <i>Protium copal</i> (Schl. & Cham.) Engl. 2262. Juvenile.                                |
| Anacardiaceæ  | <i>Spondias mombin</i> L. <i>Kinim</i> , <i>Jobo</i> . 2352. Juvenile.                    |
| Sapindaceæ    | <i>Cupania glabra</i> Sw. 2347. Juvenile.   |
| Dilleniaceæ   | <i>Curatella americana</i> L. <i>Saha</i> . 2266.   |
| Flacourtiaceæ | <i>Zuelania guidonia</i> (Sw.) Britt. & Millsp. <i>Tamay</i> . 2338. Juvenile.            |
| Apocynaceæ    | <i>Tabernæmontana chrysocarpa</i> Blake. <i>Cojon de caballo</i> , <i>Lecheso</i> . 2354. |

## SHRUBS:

- |                |   |
|----------------|---|
| Olacaceæ       | <i>Schæpfia schreberi</i> Gmel. <i>Limoncillo</i> . 2326.                                     |
| Leguminosæ     | <i>Acacia spadicigera</i> Schl. & Cham. <i>Subin</i> . 2240.                                  |
|                | <i>Mimosa albida</i> Humb. & Bonpl. 2269.   |
| Erythroxylaceæ | <i>Erythroxylon areolatum</i> L. <i>Limoncillo</i> . 2250.                                    |
| Malpighiaceæ   | <i>Byrsonima crassifolia</i> (L.) HBK. <i>Nanze</i> . 2348.                                   |
| Sapindaceæ     | <i>Allophylus cominia</i> (L.) Sw. 2246, 2255.  |
| Malvaceæ       | <i>Malvaviscus brevibracteatus</i> E. G. Baker. <i>Tulipan</i> . 2265.                        |
| Flacourtiaceæ  | <i>Casearia aculeata</i> Jacq. <i>Pullun</i> . 2225, 2254, 2327, 3634.                        |
|                | <i>Xylosma hemsleyana</i> Standl. (?). 2247.  |
| Myrtaceæ       | <i>Eugenia capuli</i> (Schl. & Cham.) Berg. <i>Chilonche</i> , <i>Escobillo</i> . 2329, 2336. |
| Melastomataceæ | <i>Conostegia xalapensis</i> (Bonpl.) Don. <i>Pasita</i> . 2245.                              |
| Myrsinaceæ     | <i>Ardisia compressa</i> HBK. (?). 2264.  |
| Verbenaceæ     | <i>Callicarpa acuminata</i> HBK. <i>Ceniciento</i> . 2344, 3635.                              |
|                | <i>Cornutia pyramidata</i> L. var. <i>isthmica</i> Moldenke. 2252.                            |
| Solanaceæ      | <i>Lycianthes variifolia</i> Standl. 2331.  |
| Rubiaceæ       | <i>Psychotria sessilifolia</i> Mart. & Gal. 2263.   |
|                | <i>Randia aculeata</i> L. 2224.   |
| Compositæ      | <i>Vernonia aschenborniana</i> Schauer. 2226.   |

## LIANAS:

- |             |  |
|-------------|--|
| Connaraceæ  | <i>Cnestidium rufescens</i> Planch. <i>Bejuco colorado</i> . 2223, 2345. |
| Sapindaceæ  | <i>Serjania atrolineata</i> Sauv. & Wright. 2334, 2365, 2366.            |
| Dilleniaceæ | <i>Davilla kunthii</i> St. Hil. 2253.                                    |
|             | <i>Tetracera volubilis</i> L. <i>Bejuco de cachicon</i> . 2260.          |
| Rubiaceæ    | <i>Chiococca alba</i> (L.) Hitchc. 2351.                                 |

## SUFFRUTESCENT VINES:

- |               |  |
|---------------|--|
| Smilacaceæ    | <i>Smilax spinosa</i> Mill. <i>Diente de perro</i> . 2259, 2270, 2337. |
| Menispermaceæ | <i>Cissampelos pareira</i> L. 2257.                                    |

Leguminosæ	<i>Centrosema virginianum</i> (L.) Benth. 2222, 2330, 2364. <i>Rhynchosia pyramidalis</i> (Lam.) Urban. 2228.
Passifloraceæ	<i>Passiflora biflora</i> Lam. 2271, 2272. <i>Passiflora coriacea</i> Juss. 2349. <i>Passiflora fœtida lanuginosa</i> Killip. Tujo. 2227.
Apocynaceæ	<i>Mandevilla subsagittata</i> (R. & P.) Woods. 2333, 2363.
SUFFRUTESCENT SCRAMBLERS:	
Gramineæ	<i>Lasiacis divaricata</i> (L.) Hitchc. 2249.
Compositæ	<i>Eupatorium odoratum</i> L. 2361.
HERBS:	
Gramineæ	<i>Lithachne pauciflora</i> (Sw.) Beauv. 2328. <i>Oplismenus hirtellus</i> (L.) Beauv. 2357.
Cyperaceæ	<i>Fimbristylis preslii</i> Kunth. 2340.
Malvaceæ	<i>Sida acuta</i> Burm. 2268.
Compositæ	<i>Elephantopus mollis</i> HBK. 2251.
EPIPHYTES:	
Polypodiaceæ	<i>Nephrolepis pendula</i> (Raddi) J. Sm. (?). 2258.
Araceæ	<i>Syngonium podophyllum</i> Schott. 2550.
Orchidaceæ	<i>Epidendrum stenopetalum</i> Hook. 2230. <i>Jacquinella globosa</i> Schltr. 2236, 2256. <i>Oncidium ascendens</i> Lindl. 2332. <i>Pleurothallis comayaguensis</i> Ames. 2235. <i>Pleurothallis marginata</i> Lindl. 2339. <i>Scaphyglottis livida</i> (Lindl.) Schltr. 2231.
Moraceæ	<i>Ficus cookii</i> Standl. (?). 2267. Hemi-epiphyte.

UNDRAINED SINKHOLES (*Aguadas*)

Undrained sinkholes, some holding water throughout the year, others drying out only toward the end of the dry season, are all called *aguadas* (Plates 33 and 34). They are the source of water for the savanna people, as well as the cattle, and therefore of great importance especially during the dry season. In some areas of the *campo*, as around La Libertad, *aguadas* are numerous.

The *aguadas* appear to be large sinkholes whose underground outlets have been plugged. The soils of their basins are heavy impervious clays (p. 86). Some *aguadas* cover as much as 5 acres during flood periods, but their average size is probably less than 2 acres. Seldom do they exceed 2 meters in depth.

Inasmuch as these pools are the only source of water during the dry season, cattle frequent them, tramping the banks, standing and wading in the water. Naturally such disturbances have affected the vegetation. Only one small *aguada* was found which appeared little modified. The basins which dry out during the dry season are overrun by a group of annuals of which the specific composition is characteristic, yet varies considerably from place to place.

Most *aguada* banks are overgrown by shrubs and shaded by trees typical of the habitat. However, there are some *aguadas* such as the one at Polol (Plate 33, fig. 2), which lie more or less exposed in the open *campo*. Others have banks only partially wooded.

In order to picture the variation and give an adequate conception of the vegetation associated with the *aguadas*, several were studied in some detail and are discussed individually.

*Aguada Chimah Pequeño (zapotebobal)*—The least disturbed of the *aguadas* encountered was Chimah Pequeño located about 8 km. northwest of La Libertad. It is a small sink almost completely surrounded by scrubby bush and frequented less by cattle than many of the others in the vicinity. The entire basin was overgrown with two sedges both called *polol*, *Eleocharis interstincta* (Lundell 2363) and *Cyperus articulatus* (3262), the former rather low, the latter more than a meter in height. When I visited the place, alligators were splashing through the mucky slush, for the water was reduced to a small shallow pool. Cattle attempting to reach the water became bogged in the waxy, tenacious clays, and one dead cow was rotting there when I made the collections.

The sink was bordered by low trees, the swamp-loving *zapotebobo*, *Pachira aquatica* (Lundell 3260), the *palo tinta*, *Hæmatoxylum campechianum* (3261), the *copo*, *Ficus radula* (3264), and two tall shrubs, *Ouratea peckii* (3258) and *Helicteres guazumæfolia* (3259). The large liana, *Banisteria laurifolia* (3257), then in flower, covered an entire tree crown, its bright yellow and reddish inflorescences being very conspicuous at the time.

As Bartlett (1935) found in Northern Petén, the presence of the *zapotebobo* trees around an *aguada*, especially in a *bajo*, indicates treacherous boggy conditions. The habitat is called a *zapotebobal*.

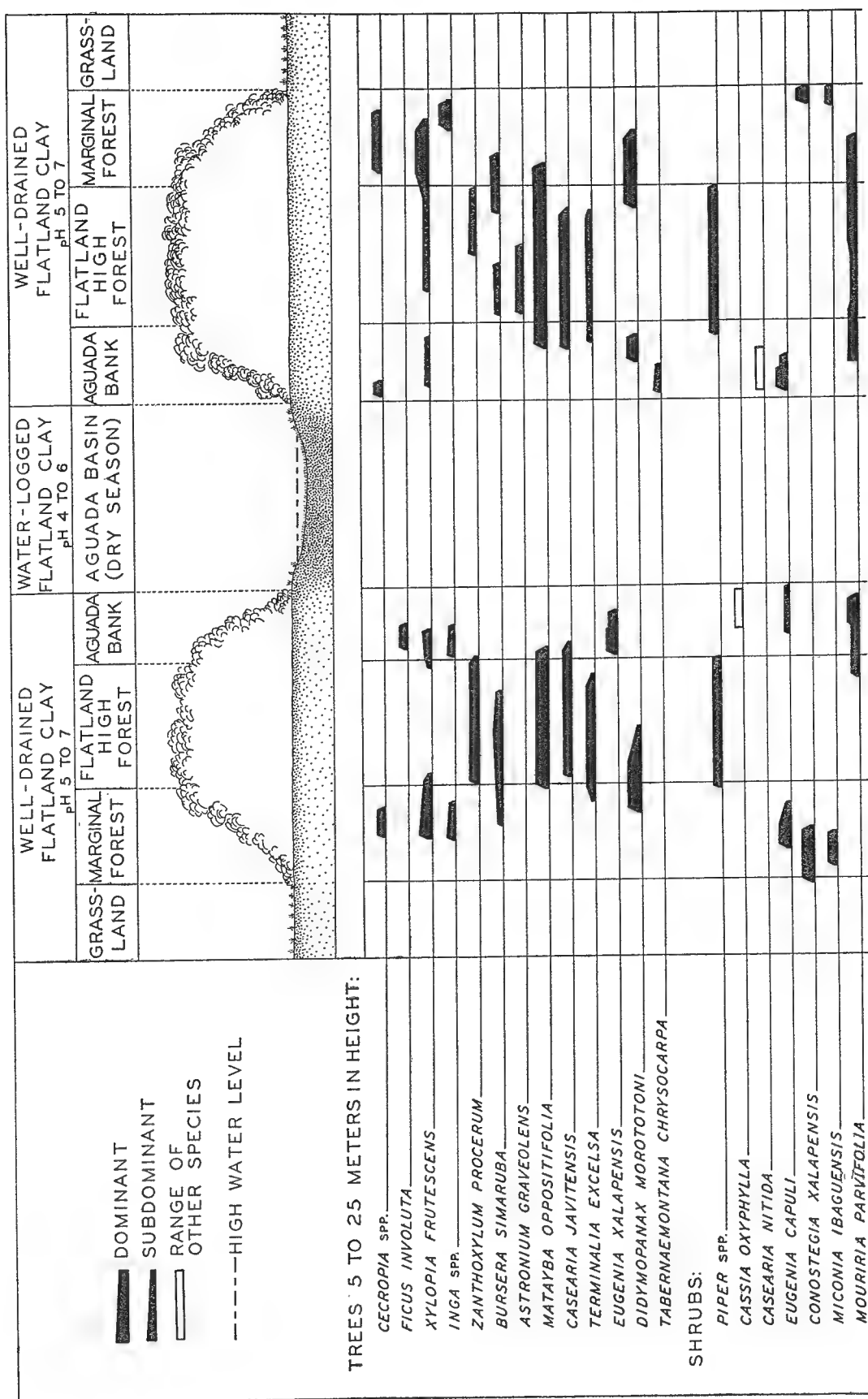
*Aguada El Progreso*—During the wet season Aguilar made collections in this sinkhole. Among the aquatics he found the *hierba del carbunco*, *Ipomœa asarifolia* (Aguilar 134), and one of the plants known as *pan caliente*, *Lophotocarpus guyanensis* (Aguilar 173). On the moist banks he collected *Leersia hexandra* (Aguilar 168), *Cyperus cayennensis* (Aguilar 197), *C. compressus* (Aguilar 183), *Bacopa rotundifolia* (Aguilar 179), *Caperomia palustris* (Aguilar 132), *Bidens pilosa* (Aguilar 80), *Cassia stenocarpa* (Aguilar 314), and the *miramelinda*, *Cleome serrata* (Aguilar 107).

*Aguada Chachachuum*—This sink is completely surrounded by high flatland forest (fig. 2 and Plate 33, fig. 1). From April to June 1933, the basin was dry and the heavy clay soils cracked deeply. The bottom was completely overrun by annuals, the small prostrate *Eragrostis hypnoides* (Lundell 2522), *Trichospira menthoides* (3335), *Heliotropium procumbens* (2524), *H. filiforme* (2521), *Kyllinga pumila* (2498), and *Panicum laxum* (2526).

Around edges of the *aguada* were larger herbs, *Paspalum orbiculatum* (Lundell 2527), *Cyperus luzulæ* (2523), *Cuphea carthagenensis* (2520), *Struchium sparganophorum* (2530), and *Stachytarpheta angustifolia* (2519; Aguilar 198) (fig. 2).

The bordering shrub, liana, and tree growth surrounding it is characteristic of such habitats in the savanna country (Plate 33, fig. 1). The shrubby *Cassia oxyphylla* (Lundell 2543), the *chilonche*, *Eugenia capuli* (2541), *Eugenia xalapensis* (2504), *Mouriria parvifolia*, *Casearia nitida* (3627), *Tabernæmontana chrysocarpa* (2505), *Cecropia* sp., and the liana *Doliodarpus dentatus* (2525) were prominent in the shrub belt near the *aguada* edge (fig. 2). Behind this narrow belt in the transitional tree zone grew the *bitze*, *Inga leptoloba* (2537), the *copo*, *Ficus involuta* (2497), *Xylopia frutescens*, *Matayba oppositifolia*, *Casearia javitensis*, *Terminalia*





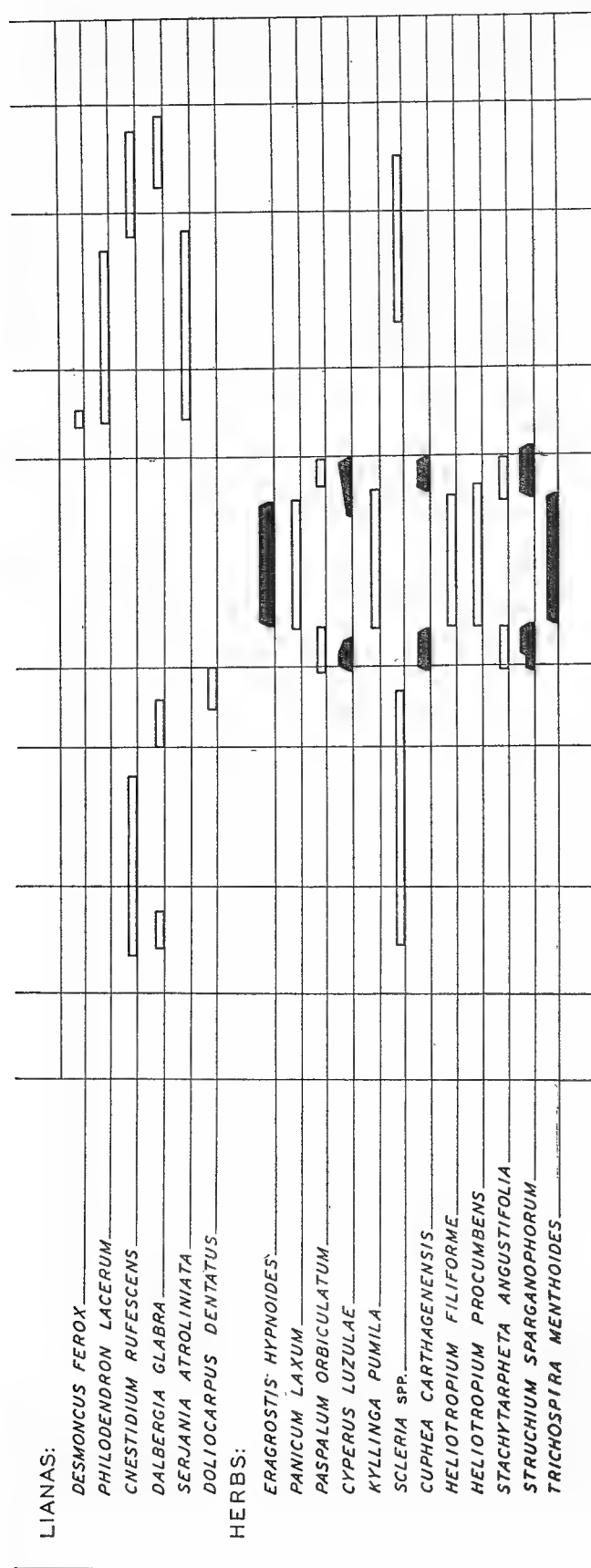


Fig. 2—Diagrammatic cross-section through Aguada Chachacluum.

*excelsa*, *Didymopanax morototoni*, and the shrubby *Mouriria parvifolia*. Climbing on these were two lianas, the *kibix*, *Dalbergia glabra* (2529), and *Serjania atrolineata* (2515). One large individual of the spiny scrambler, *Desmoncus ferox* (2646), was conspicuous. The large root-climbing aroid, *Philodendron lacerum* (?) (2645), covered the trunk of one of the trees.

In the diagrammatic cross-section of Aguada Chachacluum (fig. 2), the position of the basin and the zonal distribution of the vegetation are shown.

*Aguada Chicah*—This *aguada* very closely resembles Aguada Chachacluum, although considerably larger. The central sections of the bottom of the basin were barren, but around the shaded margin grew numerous herbs of which I collected one of the plants called *chichibe*, *Cuphea carthagenensis* (Lundell 2584, 3477), the *mastuerzo*, *Scoparia dulcis* (Lundell 2582), *Commelina longicaulis* (Lundell 2587), *Jussiaea suffruticosa* (Lundell 2586; Aguilar 133), *Oldenlandia herbacea* (Lundell 2583), and *Paspalum orbiculatum* (Lundell 2585). In this *aguada* I found the small aquatic pteridophyte, *Marsilia berteroi* (Lundell 2579), which at the time had dried up almost entirely. It is undoubtedly a prominent aquatic during the wet season.

Two large shrubs, the *chicharillo*, *Mouriria parvifolia* (Lundell 2576), and the *chilonche*, *Eugenia capuli* (2581), were commonest in

the shrub belt at the *aguada* edge. The *zacuayum*, *Matayba oppositifolia* (2514), was among the larger trees present in the transitional zone. The zonal distribution of the vegetation of this *aguada* is much the same as that around Aguada Chachacluum.

*Aguada Yaxnic*—This is a large shallow sink at the edge of Monte Chicbul (Plate 34). On one side it is bordered by scrubby thorny growth and on the other by transitional zone forest similar to that around Aguada Chachacluum (fig. 2). A narrow section of the bank is open to the savanna.

Cattle frequent the place to such an extent that scarcely any herbaceous growth can persist during the dry season. When the water receded in May, one small tiny sedge, a species of *Eleocharis*, overran the muds. Around the outer edges were only a few plants of the perennial *Melochia hirsuta* (Lundell 2612). The *berenjena*, *Solanum diversifolium* (3341), a tall shrub, formed a small thicket on the side adjoined by mesophytic forest.

On the side bordered with scrubby thorn growth I collected the *saaxnic*, *Ximenia americana* (2575), the *texpac*, *Guettarda combsii* (3092), and the *jolte*, *Miconia argentea* (3084). The *pakay* or *uapinol*, *Hymenæa courbaril* (3459), a giant tree with wide-spreading crown, covered a considerable stretch of the bank.

On the side of the *aguada* bordered by high forest and an abandoned *milpa* the trees of the transitional zone were the *copo*, *Ficus involuta* (Lundell 3093); the *bakelak de aguada*, *Casearia nitida* (3089); the *bitze*, *Inga punctata* (3090); *Alchornea latifolia* (3083); and three species of the bullhorn *Acacia*, all called *subin*. Two lianas, *Doliocarpus dentatus* (3085) and *Hippocratea yucatanensis* (2606, 3330), were collected in the same belt. For additional data on Aguada Yaxnic see figure 3 and page 121.

Another dry basin, known as Aguada San Francisco, was open to the savanna on two sides. During April and May its bottom was overgrown with *Heliotropium filiforme* (Lundell 3632) and other small herbs. The wooded sections of the banks were covered with a dense thicket of three shrubby species, the *chilonche*, *Eugenia capuli*, *Trichilia trifolia* (2600), and *Helicteres guazumæfolia* (2595).

In dry basins of various other *aguadas*, *Trichospira menthoides*, the *chamico*, *Heliotropium indicum*, the *kusan*, *H. parviflorum*, *H. procumbens*, and *Cleome aculeata* were collected. Trees, shrubs, and vines found on the banks of these *aguadas* included the *naranjillo*, *Zanthoxylum procerum*, the *espino*, *Z. kellermanii*, the *copo*, *Ficus involuta*, *F. tuerckheimii*, *F. lundellii*, the *cojon de caballo*, *Tabernaemontana chrysocarpa*, *Casearia sylvestris*, *Coccoloba schiedeana*, and the liana, *Banisteria laurifolia*. The giant *pakay*, *Hymenæa courbaril*, was found only on *aguada* banks.

Although it can scarcely be classed as an *aguada*, the sink known as Poso Lagarto holds water for long periods each year. It appears to be an intermediate type probably having a small underground outlet. *Trichilia trifolia* (Lundell 3024) grows in the basin forming a thicket. On its branches four Bromeliaceæ,

*Tillandsia festucoides* (2588), *T. polystachya* (2593), *T. schiedeana* (2592), and *T. valenzuelana* (2591) were collected. At the same place, the liana, *Banisteria laurifolia* (3025), was growing on the sloping bank.

In summarizing we note that *aguada* vegetation is of two types: (1) that of the basins and (2) that of the banks. If the basins are flooded throughout the year, they may support aquatic vegetation. However, whether or not aquatics exist in an *aguada* is dependent upon external conditions to a large extent, for disturbances by cattle may entirely eliminate plant growth. Chimah Pequeño with its sedge association was the only sink showing indications of having little-disturbed aquatic vegetation.

If the basins dry out for several months each year, they are overrun by characteristic annuals. Although the specific composition varies from place to place, and one plant may be dominant in one dry *aguada* basin and be entirely absent in another, the wide distribution of most of the species of such areas is evidence enough to show that the habitat has a characteristic vegetation. Considering the heavy clay acid soils and the seasonal changes of such *aguadas*, one would expect to find a flora adapted to extreme conditions. The wet season aspects of the seasonal *aguadas* are not known. However, the finding of *Marsilia* in Aguada Chicah indicates that aquatics may be prominent. Aguilar collected several in Aguada El Progreso.

If *aguada* banks are low and somewhat swampy, as around Chimah Pequeño, swamp-loving shrubs, lianas, and trees will dominate, giving such associations as the *zapotebobal* and *tintal*. *Aguadas* with swampy wooded banks are rare in the savanna country. *Aguadas* surrounded entirely by high mesophytic forest (fig. 3) will have typical bank growth consisting of a belt of shrubs, lianas, and low trees, followed inland by a transitional zone of taller trees and lianas. If the undrained sink lies at the edge of savanna forest, the banks toward the savanna side may be overgrown by a thicket of shrubby species or entirely open with well-drained *campo* vegetation. *Aguadas* lying in the open *campo* unsurrounded by forest may support on their banks the well-drained grassland or the *bobolar* association depending on drainage conditions.

The 79 species collected in and around the *aguadas* are given in the following list. The collection numbers are those of the writer, unless otherwise indicated.

## TREES:

Moraceæ	<i>Ficus involuta</i> (Liebm.) Miq. Copo. 2497, 2973, 3093, 3351.
	<i>Ficus lundellii</i> Standl. 3655.
	<i>Ficus radula</i> Willd. 3264.
	<i>Ficus tuerckheimii</i> Standl. 3276.
Polygonaceæ	<i>Coccoloba schiedeana</i> Lindau. 3212, 3230.
Lauraceæ	<i>Misanteca campechiana</i> (Standl.) Lundell. Ektit. 3065.
	<i>Nectandra globosa</i> (Aubl.) Mez. (?). Zunonte. 3628.
	<i>Nectandra membranacea</i> Griseb. (?). Laurel. 2578.
Leguminosæ	<i>Hæmatoxylum campechianum</i> L. Palo tinta. 3261.
	<i>Hymenæa courbaril</i> L. Pakay, Uapinol. 3044, 3459; Aguilar 253.
	<i>Inga leptoloba</i> Schlecht. Bitze. 2537.
	<i>Inga punctata</i> Willd. Bitze. 3090.

- Rutaceæ *Zanthoxylum kellermanii* P. Wilson. *Espino*. Aguilar 128.  
*Zanthoxylum procerum* Donn. Sm. *Kixche*, Choonte, Naranjillo. 2972.  
Meliaceæ *Trichilia trifolia* L. 2600, 3024.  
Euphorbiaceæ *Pera barbellata* Standl. 3067.  
Sapindaceæ *Matayba oppositifolia* (A. Rich.) Britton. *Zacuayum*. 2514.  
Bombacaceæ *Pachira aquatica* Aubl. *Zapotebobo*. 3260.  
Flacourtiaceæ *Casearia nitida* (L.) Jacq. *Bakelak de aguada*. 3089, 3627, 3723. A shrub or small tree.  
*Casearia sylvestris* Sw. 2610. A shrub or small tree.  
Combretaceæ *Terminalia excelsa* Liebm. *Kanxan*, Pucte. 2512.  
Melastomataceæ *Miconia argentea* (Sw.) DC. 3084.
- SHRUBS OR TREELETS:
- Olacaceæ *Ximenia americana* L. *Saaxnic*, *Tocote de monte*. 2575, 3270, 3331.  
Leguminosæ *Acacia cookii* Safford (?). 2611.  
*Cassia oxyphylla* Kunth. 2543.  
Sterculiaceæ *Helicteres guazumæfolia* HBK. 2595, 3259.  
Ochnaceæ *Ouratea peckii* Riley. 3258.  
Myrtaceæ *Eugenia capuli* (Schl. & Cham.) Berg. *Chilonche*, *Escobillo*. 2541, 2581, 2602; Aguilar 236.  
*Eugenia xalapensis* (HBK.) DC. 2504.  
Melastomataceæ *Mouriria parvifolia* Benth. *Chicharillo*. 2576.  
Ebenaceæ *Diospyros* sp. *Chalhac*. Aguilar 286.  
Apocynaceæ *Tabernaemontana chrysocarpa* Blake. *Cojon de caballo*. 2505, 2845, 3228.  
Solanaceæ *Solanum diversifolium* Schlecht. *Baxbalum*, *Berenjena*. 3341.  
Rubiaceæ *Guettarda combsii* Urban. *Texpac*, *Textop*. 3092.
- LIANAS:
- Leguminosæ *Dalbergia glabra* (Mill.) Standl. *Kibix*. 2529.  
Malpighiaceæ *Banisteria laurifolia* L. 3025, 3257, 3430.  
Hippocrateaceæ *Hippocratea yucatanensis* Standl. 2606, 3330; Aguilar 379.  
Sapindaceæ *Serjania atrolineata* Sauv. & Wright. 2515.  
Dilleniaceæ *Dolioscarpus dentatus* (Aubl.) Standl. 2525, 3085.
- HERBACEOUS VINE:
- Convolvulaceæ *Ipomæa asarifolia* (Desv.) R. & S. *Hierba del carbunco*. Aguilar 134, 234.
- HERBS:
- Marsiliaceæ *Marsilia berteroi* A. Br. 2579.  
Alismaceæ *Lophotocarpus guyanensis* (HBK.) J. G. Smith. *Pan caliente*. Aguilar 173.  
Gramineæ *Eragrostis hypnoides* (Lam.) B. S. P. 2522.  
*Leersia hexandra* Sw. Aguilar 168.  
*Panicum laxum* Sw. 2526.  
*Paspalum orbiculatum* Poir. 2527, 2585.  
Cyperaceæ *Cyperus articulatus* L. Polol. 3262.  
*Cyperus cayennensis* (Lam.) Britton. Aguilar 197.  
*Cyperus compressus* L. Aguilar 183.  
*Cyperus luzulæ* (L.) Retz. 2523.  
*Eleocharis interstincta* (Vahl) R. & S. Polol. 3263.  
*Eleocharis* sp. *Pan caliente*. 3097.  
*Eleocharis* sp. 2580.  
*Kyllinga pumila* Michx. 2498.  
*Rynchospora* sp. 2518.  
Commelinaceæ *Commelina longicaulis* Jacq. 2587.  
Capparidaceæ *Cleome aculeata* L. Aguilar 116.  
*Cleome serrata* Jacq. *Miramelinda*. Aguilar 107.  
Leguminosæ *Cassia stenocarpa* Vog. Colhat. Aguilar 314.  
Euphorbiaceæ *Caperonia palustris* (L.) St. Hil. Aguilar 132.  
Sterculiaceæ *Melochia hirsuta* Cav. 2612.  
Lythraceæ *Cuphea carthagenensis* (Jacq.) Macbride. *Chichibe*. 2520, 2584, 3477; Aguilar 37, 104.

Onagraceæ	<i>Jussiaea suffruticosa</i> L. 2586; Aguilar 133.
Boraginaceæ	<i>Heliotropium filiforme</i> Lehm. 2521, 3632. <i>Heliotropium indicum</i> L. Chamico. 3030. <i>Heliotropium parviflorum</i> (DC.) Griseb. Kusan, Golondrina. 3034; Aguilar 265. <i>Heliotropium procumbens</i> Mill. 2524, 3479.
Verbenaceæ	<i>Stachytarpheta angustifolia</i> (Mill.) Vahl. 2519; Aguilar 198.
Labiatae	<i>Hyptis americana</i> (Aubl.) Urban. Aguilar 227.
Scrophulariaceæ	<i>Bacopa rotundifolia</i> (Michx.) Wettst. Aguilar 179. <i>Scoparia dulcis</i> L. Mastuerzo. 2582.
Rubiaceæ	<i>Oldenlandia herbacea</i> (L.) DC. 2583.
Compositæ	<i>Bidens pilosa</i> L. Aguilar 80. <i>Struthium sparganophorum</i> (L.) Kuntze. 2530. <i>Trichospira menthoides</i> HBK. 3029, 3335; Aguilar 38.

## EPIPHYTES:

Bromeliaceæ	<i>Tillandsia festucoides</i> Brongn. 2588. <i>Tillandsia polystachya</i> L. 2593. <i>Tillandsia schiedeana</i> Steud. 2592. <i>Tillandsia valenzuelana</i> A. Rich. 2591.
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## FLATLAND FORESTS AND MILPA CLEARINGS

In order to obtain authentic data on the floristic composition, distribution of species, dominance, and successional stages in the flatland forest, a transect was made through a typical area. For the detailed analysis I chose a strip of the Monte Chicbul, and ran the transect from the open grassland through the forest to the edge of the Yaxnic Aguada (fig. 3). From the edge of the savanna to the edge of the *aguada* the distance was 128 meters. The width of the transect was set as 16 meters, and lines were cut on each side before the work was begun.

It was possible by preliminary observations to determine the approximate boundaries of the ecological zones within the 128 meter strip. Beginning at the *aguada* side, the *aguada* bank zone extended for about 12 meters (section 2, fig. 3). Next came the central high forest which for convenience I divided into three areas 24, 40, and 22 meters, respectively, in length (sections 3, 4, and 5, fig. 3). On the savanna side the belts of marginal growth covered a zone 30 meters in length (section 6, fig. 3).

The total area of the transect strip was 2048 square meters, of which 192 square meters were covered with *aguada* bank vegetation, 1376 square meters with flatland high forest, and 480 square meters with marginal forest.

This forested area through which the transect was cut is typical of all the flatland forest of the savanna country in the vicinity of La Libertad. I did not find a single area of vegetation in the savanna country which could be classed as climatic climax; the nearest approach to it on the deep clay soils was the flatland high forest which I class as sub-climax. The forest area through which the transect was cut is still subject to disturbances by man, fire, and cattle. The same is equally true of all other flatland forest areas in that locality.

The forest contains certain valuable trees such as the mahogany (*caoba*), many of which are cut for local usage, hence leaving a culled stand. The flatland forest is also occasionally swept by fires which disturb the undergrowth and





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(Continued on page 124)



(Continued on page 126)

<i>MOURIRIA PARVIFOLIA</i> 2 TO 5 METERS JUVENILE	15	5 4.5	8 8.4	3 2.6	2 1.4
<i>THEVETIA AHOUI</i> 2 TO 5 METERS JUVENILE		1	5 2	3 1	1 1
** <i>SOLANUM DIVERSIFOLIUM</i> < 2 METERS	18				
* <i>ALIBERTIA EDULIS</i> 2 TO 5 METERS JUVENILE	19 3.9	6 5.0	5.6 7.6	2.8 5.3	4.3 4.1
* <i>PSYCHOTRIA HORIZONTALIS</i> < 2 METERS JUVENILE	6 1.8	12.0 5.0	19.6 8.8	8.6 5.9	3.2 4.0
<i>PSYCHOTRIA UNDATA</i> < 2 METERS	2	3.1	6.2	4.8	1.2
<i>RONDELETIA BELIZENSIS</i> 2 TO 5 METERS					1
LIANAS AND SCRAMBLERS:					
<i>LASIACIS DIVARICATA</i> SCRAMBLER					1
<i>DESMONCUS</i> sp. JUVENILE			1		1
<i>SMILAX</i> sp. SECOND STORY FIRST STORY			2	1	2
<i>CNESTIDIUM RUFESCENS</i> FIRST STORY JUVENILE	8	1 1.2	2 1.1	2 1.0	1.0 .8
<i>BAUHINIA GLABRA</i> (?) JUVENILE			1		
<i>GALACTIA BELIZENSIS</i> CLIMBING ON SHRUBS					1
<i>ALLOPHYLUS KINLOCHII</i> (?) FIRST STORY JUVENILE			1		5
<i>PAULLINIA PINNATA</i> FIRST STORY			1		

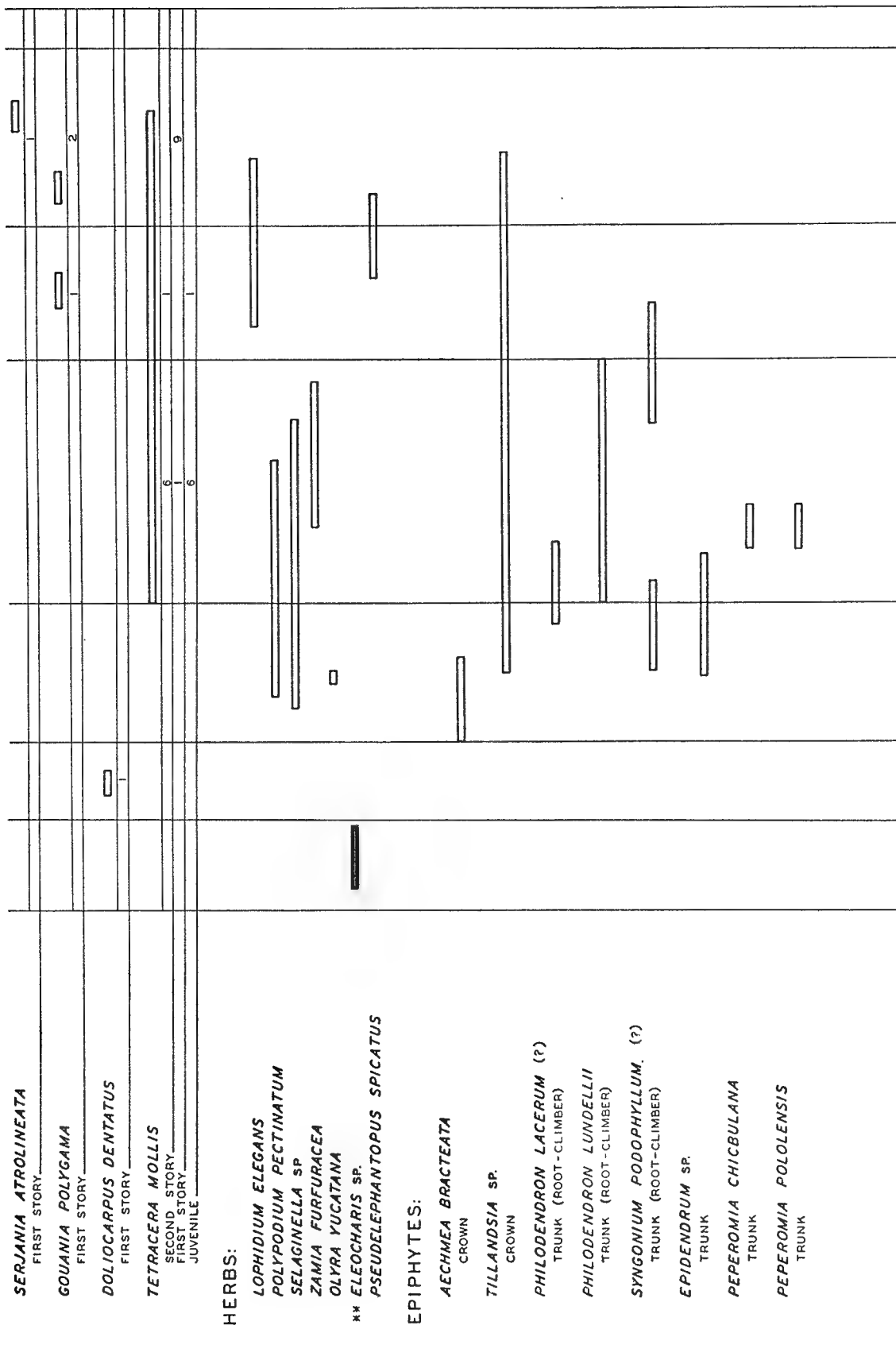


Fig. 3—Transect through a section of flatland forest in Monte Chicbul.

sometimes kill a few of the larger trees. Damage from fire in the high forest is, however, not as great as elsewhere, probably because of the more humid conditions. The marginal zone likewise is considerably disturbed by fire, as retrogression of the vegetation is evident in some places.

In the forest the influence of the cattle must be given careful consideration. As the *aguadas* are mostly located within the flatland forest, cattle frequent the areas to obtain water. Their trails are everywhere present. Aside from the water attraction, cattle use these areas more or less as shelter, especially in the dry season when the heat is excessive. Cattle may graze to a limited extent in the forest, but their influence is chiefly through tramping and manuring. The last factor is of importance, for the manure brings about luxuriant plant growth. It may account in part for the abundance of seedlings, low juveniles, and shrubs in the shaded inner zone.

A preliminary survey of the flatland high forest zone (sections 3, 4, and 5, fig. 3) showed the presence of three tree layers: the top or third story where *Swietenia*, *Terminalia*, *Cassia*, and *Matayba* species reached an estimated height of 30 meters; the second story characterized by the dominant *Matayba oppositifolia* where the trees ranged in height from about 18 to 25 meters; and the lower or first story. Below the trees were three other layers, the tall shrubs, the low shrubs, and the floor plants, chiefly ferns (see fig. 3). In the lower story, juvenile plants were exceedingly abundant.

In the marginal zone (section 6, fig. 3) and the *aguada* bank zone (section 2, fig. 3) it was possible to distinguish somewhat between the layers, although they were not as clear cut as in the inner tall forest. From the floor to the top there was a more or less continuous mass of vegetation forming a dense curtain as viewed from without.

Almost all of the trees and shrubs of the *aguada* bank zone and the flatland high forest zone were evergreen. A majority of the species in the marginal forest were deciduous, which made identification very difficult.

In the flatland high forest zone (sections 3, 4, and 5, fig. 3) the conditions were somewhat humid even in the dry season. Although the canopy was almost closed, sufficient light filtered through it and into it from the *aguada* and savanna to support abundant undergrowth. No instruments were available to record the humidity, temperature, light intensity, etc. For accurate data on the forest environment, records over a long period are essential.

The marginal forest could be considered xerophytic (at least in its dry season aspects) and the flatland high forest mesophytic. However, the tops of the crowns of the tall high-forest trees show characteristics which are common to xerophytes, *i. e.* reduced leaf size, glossy surfaces, pubescence, thick cuticle, etc., protections against excessive transpiration, insolation, etc.

The transect was begun on the *aguada* side. A record was made of every individual of every species (see fig. 3). Herbarium specimens were taken throughout for accurate determination of the species. A number were sterile and some

were represented only by juveniles. The determinations of some of these are doubtful and such are indicated by a (?) after the name. After a plant had been identified or collected, the common name or a number was employed to designate the species in recording the individuals.

It was found impracticable to try to recognize seedlings and juvenile plants less than 50 cm. in height, so they were disregarded. Juvenile plants above 50 cm. were identified with the aid of native assistants. The number of juveniles and seedlings less than 50 cm. in height was inconsiderable, relatively speaking, considering the great number 50 cm. to 2 meters in height (fig. 3).

To obtain herbarium specimens of the epiphytes, lianas, and taller trees, much of the forest in the transect belt had to be felled.

The data obtained in the transect are graphically presented in figure 3.

Because of the continuous tramping of the open bank and basin of the *aguada* by cattle, scarcely any vegetation could grow there during the dry season. One small species of *Eleocharis*, however, formed extensive dense mats over the area immediately bordering the pool where the water was receding (section 1, fig. 3).

To show the relative importance of the trees and shrubs in the three forest zones through which the transect was cut, the mass values of the species were estimated. These data are presented in table 3, which primarily reveals dominance and subdominance. Lianas, epiphytes, and herbs were relatively unimportant in considering dominance (at least in this area), therefore no attempt was made to estimate their mass values.

In estimating the mass values of the trees and shrubs (excluding juveniles) the following method was employed. The largest tree in the flatland high forest zone (fig. 3) was *Swietenia macrophylla*, which was approximately 32 meters in height with a trunk diameter of 75 cm. above the buttress, and crown spread of about 25 meters. I assigned the single giant individual of this species a mass value of 100. On the basis of its mass, I then assigned mass values to all the other species. A second-story individual of *Matayba oppositifolia* was given a mass value of 40, one of *Casearia javitensis* a mass value of 30, etc. Of the shrubs each mature individual of *Mouriria parvifolia* was assigned a mass value of 8, while each full-grown plant of *Alibertia edulis* had a mass value of only 3. Trees of the second and third stories were given full value in making calculations, but an individual of a second-story species had a mass value of only 50 per cent in the first story. The mass value of individuals of a species was multiplied by the total number of individuals to give the total mass value of the species in each of the three zones. *Matayba oppositifolia* had a total mass value of 60 in the *aguada* bank zone, 680 in the flatland high forest, and 40 in the marginal forest. The 60, 680, and 40 represent, respectively, 13.42, 17.52, and 2.43 per cent of the total mass of trees and shrubs in each of the three ecological zones (table 3).

The mass values of the individuals varied somewhat according to the zones, and adjustments were made accordingly. A first-story individual of a species would have a greater mass value in the marginal forest or *aguada* bank zone than



in the flatland high forest because of larger crown spread, the natural result of less competition where the growth was more shrubby.<sup>1</sup>

Table 3 reveals the dominance and subdominance. In the *aguada* bank zone (section 2, fig. 3) the dominants were *Miconia argentea* with 16.77 per cent of the total mass, *Matayba oppositifolia* with 13.42 per cent, and the shrub, *Solanum diversifolium*, with 10.08 per cent. The last formed a narrow belt bordering the Yaxnic Aguada, and there alone was it dominant. *Miconia argentea* dominated the lower tree belt, and *Matayba oppositifolia* the taller tree belt. The subdominants were *Inga punctata* with 8.72 per cent of total mass, *Acacia costaricensis* with 5.38 per cent, and *Alibertia edulis* with 10.75 per cent. The last dominated the tall shrub layer under the tree canopy.

In the flatland high forest zone (sections 3, 4, and 5, fig. 3), the dominant was *Matayba oppositifolia*, which represented 17.52 per cent of the total mass of all trees and shrubs. The subdominant trees were *Casearia javitensis* representing 8.86 per cent of the total mass, and *Terminalia excelsa* with 8.40 per cent. The shrubs were all heliophobous forms. Of the tall shrubs, *Hirtella racemosa* with 6.22 per cent and *Alibertia edulis* with 6.15 per cent were subdominants. The low shrub, *Psychotria horizontalis*, with 7.16 per cent must also be considered, for it comprised about 50 per cent of the cover of the low shrub layer.

In the flatland high forest zone, the *zacuayum*, *Matayba oppositifolia*, was the true dominant in percentage of mass and in the number of mature individuals. The association was designated by the natives as a *zacuayumal*, and that term is justified by the analysis of the forest.

The local distribution of the species as shown in figure 3 may be accounted for by the narrowness of the transect. Analysis of a square mile of flatland high forest would show an even distribution of the characteristic species. Marginal forest species such as *Xylopia frutescens*, *Zuelania guidonia*, and *Miconia argentea* are typical of the marginal and *aguada* bank zones, so that only occasional relics of these could be expected in the sub-climax forest.

The marginal zone (section 6, fig. 3) was made up chiefly of deciduous xerophytic and mesoxerophytic trees and shrubs. It was very diverse in floristic composition with no outstanding dominant distributed throughout. This marginal zone comprised several belts, each of which was characterized by certain species. Beginning with the savanna edge, there was a narrow low shrub belt of *Conostegia xalapensis*, a species comprising only 2.19 per cent of the mass, yet dominant in its vanguard position. Progressing inward, the inner side of the thorn-scrub belt was dominated by *Vismia ferruginea*, a species representing 10.38 per cent of the total mass of the marginal zone. Next came the intermediate low tree belt where *Miconia argentea* with 9.12 per cent of the mass was the characteristic species. The narrow transitional belt was dominated by tall trees of *Xylopia*

<sup>1</sup> In transects undertaken in June-July 1936 in forest on the limestone plateau of southern British Honduras, the writer modified this method. After the forest zones had been delimited on a physiographical basis, dominance and subdominance in each zone was determined by calculating mass values of the trees alone. Separate calculations were made for the shrubs.

*frutescens* representing 6.58 per cent of the mass and *Didymopanax morototoni* with 7.29 per cent. Under the canopy of these trees of the transitional and intermediate belts, the tall heliophobous shrubs, *Hirtella racemosa* representing 7.22 per cent of the mass and *Alibertia edulis* representing 5.85 per cent, were subdominants of the lower layer (table 3). For further discussion of the belts of the marginal forest turn to page 134.

Although very diverse floristically, the marginal zone is recognizable by characteristic species which dominate their respective belts. This is what should be expected, as the belts represent successional stages. The marginal buffer zone is a tension area of fire-resistant pioneers which are invading the savanna. Floristically it is probably the most varied of all the ecological zones of the savanna country. It has affinities with the *sequelar* of British Honduras, a similar marginal zone (see Bartlett, 1935).

In table 3 the percentage of juveniles of each tree and shrub species in each zone is also given. In making the calculations, juveniles 0.5 to 2 meters in height were assigned a value of 1 and juveniles more than 2 meters in height were given a value of 2.

In the *aguada* bank zone, the juveniles of shrubs were most abundant. Four species, *Alibertia edulis* (22.28 per cent), *Mouriria parvifolia* (8.57 per cent), *Hirtella racemosa* (7.48 per cent), and the low *Psychotria horizontalis* (10.28 per cent), were present respectively in the percentages given. Of the trees, *Nectandra globosa* (11.42 per cent), *Inga punctata* (6.86 per cent), *Calyptrotrichia chytraculia* (5.71 per cent), and *Casearia javitensis* (4 per cent) had the greatest percentages of juveniles (table 3). The surprisingly high number of juveniles of *Nectandra globosa* indicates that that species may become an important element. Although full-grown individuals of *Calyptrotrichia chytraculia*, *Hirtella racemosa*, and *Mouriria parvifolia* were absent, the species were well represented by juveniles. The prominence of juveniles of *Alibertia edulis* and *Inga punctata* was natural considering that the species were subdominants. *Casearia javitensis* and *Matayba oppositifolia* will probably become the tree dominants in the zone as succession progresses, in fact the latter was then a dominant in the tall tree belt bordering section 3 (fig. 3).

In the flatland high forest zone (sections 3, 4, and 5, fig. 3), *Nectandra globosa* with 13.62 per cent was the tree with the greatest number of juveniles. The percentages of other trees prominently represented were *Calyptrotrichia chytraculia* (7.37 per cent), *Inga punctata* (4.56 per cent), *Casearia javitensis* (4.37 per cent), and *Matayba oppositifolia* (4.30 per cent). Tall shrubs most abundantly represented by juveniles were *Alibertia edulis* (11.19 per cent), *Hirtella racemosa* (10.68 per cent), and *Mouriria parvifolia* (9.69 per cent). The low shrubs prominently represented by juveniles were *Psychotria horizontalis* with 12.37 per cent and *Piper emancipationis* with 4 per cent. It would be of interest in following the successional stages in such an area to obtain data concerning the percentages of juveniles of such species which might reach maturity. The number of juveniles

TABLE 3—Relative Mass Values of Trees and Shrubs, and Juveniles of Trees and Shrubs in Transect through Flatland Forest

	Trees and shrubs			Juveniles of trees and shrubs		
	Percentage of mass			Percentage of mass		
	Aguada Bank	Flatland High Forest	Marginal Forest	Aguada Bank	Flatland High Forest	Marginal Forest
<b>TREES:</b>						
<i>Brosimum alicastrum</i> .....	.....	0.34	.....	0.57	0.74	0.33
<i>Cecropia</i> sp.....	.....	.....	0.61	.....	.....	.....
<i>Ficus involuta</i> .....	4.47	.....	1.21	.....	.....	.....
<i>Xylopia frutescens</i> .....	0.89	0.63	6.58	2.85	0.62	6.95
<i>Nectandra globosa</i> .....	.....	2.05	3.04	11.42	13.62	6.78
<i>Nectandra membranacea</i> (?).....	.....	.....	.....	2.28	.....	.....
<i>Nectandra</i> sp.....	.....	0.91	.....	3.42	1.48	2.37
<i>Acacia cookii</i> .....	7.36	1.48	2.42	.....	3.81	2.54
<i>Acacia costaricensis</i> .....	5.38	.....	.....	1.14	0.13	0.33
<i>Cassia moschata</i> .....	.....	1.70	.....	.....	.....	.....
<i>Hymenaea courbaril</i> .....	.....	.....	.....	.....	0.12	.....
<i>Inga punctata</i> .....	8.72	1.37	3.63	6.86	4.56	2.37
<i>Piscidia piscipula</i> .....	.....	.....	1.21	.....	.....	.....
<i>Zanthoxylum procerum</i> .....	.....	1.98	.....	.....	0.25	.....
<i>Swietenia macrophylla</i> .....	.....	4.41	.....	.....	0.12	.....
<i>Trichilia arstediana</i> (?).....	.....	0.91	.....	.....	.....	.....
<i>Simaruba glauca</i> .....	.....	2.96	1.82	.....	0.06	0.85
<i>Protium copal</i> .....	.....	2.05	1.82	.....	1.56	0.85
<i>Bursera simaruba</i> .....	.....	5.12	1.52	.....	0.56	0.33
<i>Alchornea latifolia</i> .....	4.48	.....	.....	.....	.....	.....
<i>Astronium graveolens</i> .....	3.35	2.39	2.74	1.15	1.56	1.02
<i>Metopium brownei</i> .....	4.49	0.46	0.61	.....	.....	0.68
<i>Spondias mombin</i> .....	.....	0.45	.....	.....	.....	.....
<i>Matayba oppositifolia</i> .....	13.42	17.52	2.43	2.28	4.30	6.78
<i>Vismia ferruginea</i> .....	1.34	.....	10.38	.....	.....	12.71
<i>Rheedia edulis</i> .....	.....	.....	.....	.....	0.07	.....
<i>Cochlospermum vitifolium</i> .....	.....	.....	0.36	.....	.....	.....
<i>Casearia javitensis</i> .....	3.35	8.86	.....	4.00	4.37	1.72
<i>Latia thamnia</i> .....	.....	0.68	.....	0.57	3.00	.....
<i>Zuelania guidonia</i> .....	.....	0.91	2.42	3.42	0.87	0.17
<i>Terminalia excelsa</i> .....	.....	8.40	4.84	0.57	0.19	2.89
<i>Calyptanthus chytaculia</i> .....	.....	1.37	3.63	5.71	7.37	12.71
<i>Miconia argentea</i> .....	16.77	0.46	9.12	.....	0.19	2.21
<i>Aralia</i> (?).....	.....	1.48	0.91	.....	0.20	.....
<i>Didymopanax morototoni</i> .....	.....	.....	7.29	.....	.....	0.51
<i>Chrysophyllum oliviforme</i> (?).....	.....	.....	1.82	.....	0.19	0.68
<i>Stemmadenia grandiflora</i> (?).....	.....	0.56	.....	.....	0.20	.....
<i>Cordia</i> (?).....	.....	.....	.....	.....	0.06	.....
<i>Vitex gaumeri</i> .....	.....	0.46	1.21	.....	.....	.....
<i>Guettarda combsii</i> .....	3.35	1.13	.....	0.58	0.13	1.19
Unidentified species.....	.....	0.46	3.76	0.58	0.69	0.51
<b>SHRUBS AND TREELETS:</b>						
<i>Cryosophila argentea</i> .....	.....	.....	.....	.....	0.06	.....
<i>Piper emancipationis</i> .....	.....	3.24	1.94	1.71	4.00	4.74
<i>Hirtella americana</i> .....	.....	.....	.....	.....	0.06	.....
<i>Hirtella racemosa</i> .....	.....	6.22	7.22	7.48	10.68	6.61
<i>Byrsonima crassifolia</i> .....	.....	.....	0.97	.....	.....	0.17
<i>Acalypha lancetilla</i> .....	.....	.....	.....	.....	.....	0.17
<i>Curatella americana</i> .....	.....	.....	1.21	.....	.....	.....
<i>Eugenia capuli</i> .....	.....	0.11	1.21	2.28	0.68	0.52
<i>Conostegia xalapensis</i> .....	.....	.....	2.19	.....	.....	3.89
<i>Mouriria parvifolia</i> .....	.....	2.91	0.98	8.57	9.69	2.37
<i>Thevetia ahouai</i> .....	.....	0.18	0.06	.....	0.25	0.17
<i>Solanum diversifolium</i> .....	10.08	.....	.....	.....	.....	.....
<i>Alibertia edulis</i> .....	10.75	6.15	5.85	22.28	11.19	6.94
<i>Psychotria horizontalis</i> .....	1.35	7.16	1.95	10.28	12.37	6.94
<i>Psychotria undata</i> .....	0.45	2.53	0.73	.....	.....	.....
<i>Rondeletia belizensis</i> .....	.....	.....	0.31	.....	.....	.....

of other trees and shrubs was not unusual considering the number of mature individuals of the species in the zone.

In the marginal forest, juveniles of the shrubs were again most conspicuous. However, four trees, *Nectandra globosa* with 6.78 per cent of the juveniles, *Xylopia frutescens* with 6.95 per cent, *Matayba oppositifolia* with 6.78 per cent, and *Calyptranthes chytraculia* with 12.71 per cent, were well represented. Of these *Matayba oppositifolia* is of most interest for its juveniles probably will grow up eventually to be the dominants. The high percentage of juveniles of *Vismia ferruginea* (12.71 per cent), *Alibertia edulis* (6.94 per cent), *Hirtella racemosa* (6.61 per cent), the low *Psychotria horizontalis* (6.94 per cent), and the low *Piper emancipationis* (4.74 per cent) follows expectations. The absence of juveniles of certain species might be accounted for by fire destruction which had been severe in the zone.

The remarkable number of juveniles indicates that young plants of many of the species are apparently very tolerant. Data concerning the length of time that they would remain suppressed in the lower layer would be of the greatest importance. Those most tolerant certainly would have the greatest chance of becoming the dominants.

According to the theory which I have advanced concerning the origin of the forest on the flatlands (p. 141), the area represented by section 3, figure 3, would be the one which had been covered longest by forest. After establishment around the sinkhole, the pioneers have invaded the *aguada* and the savanna. As the vanguard pioneers advanced, mesoxerophytic and mesophytic forest became established, first in sections 3 and 4, then in section 5, and lastly in sections 2 and 6. Succession in the direction of section 6 is apparently much more rapid than in section 2 because of the fact that silting probably goes hand in hand with invasion on the *aguada* side, and silting in such an area is a slow process.

In view of the evidence that the forest in sections 3 and 4 was oldest, the dominance there of *Matayba oppositifolia* indicates that this species may be one of the dominants in the climatic climax forest if such a forest ever should become established in the flatlands of the savanna country.

Probably the outstanding result of the transect is that it shows the relative position of the dominants and subdominants in a tropical forest area. A species may represent as little as 10 per cent of the total mass, yet that species is as truly the dominant tree as any dominant in the forest associations in temperate and frigid latitudes. *Matayba oppositifolia* represented only 17.52 per cent of the total mass in the sub-climax flatland high forest, yet its dominance is outstanding. Its percentage of total mass exceeds that of the combined total mass of the next two important trees. Because of the fact that there is such a large assemblage of tree species in old tropical forests, any tree which represents as much as 10 per cent of the total mass should be recognized as a dominant. Although quantitative analyses have not been made in the forest of Northern Petén, rapid transects through the forest have revealed certain dominants such as *Achras zapota*, *Brosimum alicastrum*, etc., some of which may represent as little as 10 per cent of the

total mass in some areas, yet relatively speaking and taking into consideration the great assemblage of species, they must be recognized as the dominants.

In the *aguada* bank zone and in the marginal zone, each of the belts, which represent successional stages, was characterized by typical species ranging from the vanguard shrubs inward to the high mesophytic forest trees. In these zones where succession is progressing rapidly, such belts are natural, and certain species found in them are as a rule restricted primarily to such belts, *i.e.* *Conostegia xalapensis*, *Vismia ferruginea*, *Miconia argentea*, *Xylopia frutescens*, *Didymopanax morototoni*, etc.

In the transect the three major zones of the flatland forest, (1) the *aguada* bank forest, (2) the flatland high forest, and (3) the marginal forest, are clearly delimited. The *aguada* bank vegetation has been discussed on pages 114 to 119. The marginal zone as shown in the transect consists of belts of successional vegetation; these are treated in more detail in the following pages under "Marginal Forests."

The transect through the flatland high forest gives an excellent view of the phase of the mesophytic forest most often encountered in the locality. Additional data from other areas and other phases of this forest are discussed under "Flatland High Forests" (see p. 141).

#### MARGINAL FORESTS

As revealed by the transect, there lies between the grassland association of the open savanna and the forest of the hills and flatlands, a zone of characteristic marginal growth dominated by fire-resistant pioneer species variously adapted to conditions of exposure, excessive evaporation, and desiccation. Many of the species are thorny, gnarled, distorted, or wiry, with scaly or platy bark (Plate 36). Species of such genera as *Didymopanax*, *Cecropia*, and *Curatella* are few-branched. There are accompanying species of which the leaves are generally leathery, small, variously covered with pubescence and other protective coatings, in other words, adapted to the extremes of the habitat. Many of the plants are deciduous, shedding their leaves almost entirely from March to May. Epiphytes are prominent, and they are represented by four major xerophytic types: (1) tank-forming bromelioids, (2) succulent-structured orchids, (3) fleshy-stemmed root-climbing aroids, and (4) ferns and other cryptogams which undergo desiccation during the dry period. Perennials and annuals are not conspicuous during the dry season, but probably very abundant in the rainy months.

The marginal forest ranges in width from a few meters in some places to as much as half a kilometer in others. It consists of three outstanding successional stages: (1) the outer low thorn-scrub belt bordering the grasslands, (2) the intermediate belt of low trees 4 to 10 meters in height, and (3) the transitional belt of taller less xerophytic trees 10 to 20 meters in height. The last intergrades into the high mesophytic forest (see figs. 2 and 3).

Where the marginal forest zone is narrow (fig. 2) the belts may be telescoped together to such an extent that they are scarcely distinguishable. In some places,

at bases of hills particularly, I encountered instances where only the outer thorn-scrub belt was present, in which case it intergraded directly into the hill slope forest. The thorn-scrub and intermediate stages may be present with only the transitional tall tree belt absent.

The thorn-scrub belt is characterized on its outer edge by the Melastomataceæ, chiefly the *pasita*, *Conostegia xalapensis*, and species of *Miconia* and *Clidemia* (figs. 2 and 3). The other typical species of the thorn-scrub area are the *chilonche*, *Eugenia capuli*, the *kuxupche*, *Vismia ferruginea*, the bullhorn species of *Acacia*, and the *piñuela*, *Bromelia karatus*. Of equal importance is the very common liana, *Davilla kunthii*. When the melastomes are not present, the outer edge of the thorn-scrub belt may be dominated by any of these species, either individually or jointly (Plate 36).

The stands of the key species vary considerably from place to place, yet on the whole the distribution of these plants is remarkably uniform considering the intense fires which sweep the outer parts of the marginal zone almost every dry season.

*Vismia ferruginea*, *Bromelia karatas*, *Conostegia xalapensis*, and *Davilla kunthii* are limited almost exclusively to the thorn-scrub belt in the savanna country. The same can be said of a number of less important species, such as *Miconia ibaguensis* and *Clidemia dependens*. *Eugenia capuli* is most abundant in this area. From an ecological standpoint, these fire-resistant pioneers are of exceptional interest for by their invasion of the grasslands a new successional series apparently leading to reforestation is inaugurated. The importance of the shrubby melastomes in the buffer belt can not be overemphasized.

Going from the savanna inland, one first passes through the narrow thorn-scrub belt and then enters the wider intermediate belt which is dominated by large shrubs and low trees ranging from about 4 to 10 meters in height. The canopy is not closed, but on the contrary quite open, permitting sun-loving shrubs and perennials to thrive. Layering is present, but not as distinctly as in the mesophytic forest. The trees and shrubs are semi-deciduous. The floristic composition varies considerably from place to place, yet the distribution of the characteristic species is remarkably uniform. Epiphytes are very common.

Areas where fires have wrought havoc are sometimes covered with an almost pure stand of the *chechem*, *Metopium brownei*, thus giving a *chechemal*.

The characteristic species of the intermediate belt include *Simaruba glauca*, *Cecropia* spp., *Miconia argentea*, *Nectandra sanguinea*, *Piscidia piscipula*, *Lippia myriocephala*, *Zuelania guidonia*, *Lætia thamnina*, *Inga leptoloba*, *Acrocomia mexicana*, *Ximenia americana*, *Acacia* spp., *Metopium brownei*, *Casearia aculeata*, *Randia albonervia*, *Xylopia frutescens*, *Bursera simaruba*, *Curatella americana*, *Malpighia punicifolia*, *Cnestidium rufescens*, and *Dalbergia glabra*. Figures 2 and 3 graphically show the distribution of many of these.

The transitional belt, composed of trees from 10 to 20 meters in height, is quite narrow and difficult to delimit. The species of the intermediate area merge

almost imperceptibly into the transitional belt, and species of the latter intergrade into the high somewhat mesophytic forest. A majority of the intermediate belt plants are also present in the transitional tall tree area, but in most instances are not prominent there.

Most species are common or characteristic in one habitat only, or in habitats that are similar, but the same species also may be present in less favorable habitats, either as relics or invaders. Some species are ubiquitous, being distributed widely through diverse habitats, *e. g.* *Bursera simaruba*, *Metopium brownei*, *Spondias mombin*, etc.

In the transitional belt, two species, *Didymopanax morototoni* and *Xylopia frutescens*, stand out from the others. The former is almost exclusively limited to the transitional belt. The latter, although it may be characteristic also of the intermediate area, is more prominent in the transitional area (Plate 35). Among other species common in the transitional belt are *Matayba oppositifolia*, *Spondias mombin*, *Bursera simaruba*, *Ficus* spp., and *Trichilia* spp.

In the systematic list which follows I include all species collected in the three belts of the marginal forest zone. A total of 251 species are represented, which gives an idea of the floristic complexity of this tension area. The species are listed according to growth form to convey a picture of the structure of the vegetation.

For additional data on the marginal forest, refer to pages 111 and 130, and figures 2 and 3.

The collection numbers are those of the writer, unless otherwise indicated.

#### TREES 8 TO 20 METERS IN HEIGHT:

Moraceæ	<i>Coussapoa oligocephala</i> Donn. Sm. <i>Copo zotz.</i> 3535. <i>Ficus involuta</i> (Liebm.) Miq. <i>Copo.</i> 3547.
Annonaceæ	<i>Xylopia frutescens</i> Aubl. <i>Šastante</i> , <i>Majahua</i> , <i>Capulincillo.</i> 2243, 2341, 2557, 3086; <i>Aguilar</i> 371.
Lauraceæ	<i>Misanteca campechiana</i> (Standl.) Lundell. <i>Ektit.</i> 3359. <i>Nectandra sanguinea</i> Rottb. (?). <i>Sakalante</i> , <i>Laurel.</i> 2113, 3716; <i>Aguilar</i> 91, 387.
Leguminosæ	<i>Piscidia piscipula</i> (L.) Sarg. <i>Habin.</i> 3075. <i>Pithecolobium leucocalyx</i> (Britt. & Rose) Standl. 3339. A giant tree.
Burseraceæ	<i>Bursera simaruba</i> (L.) Sarg. <i>Chacah</i> , <i>Palo mulato.</i> 3013, 3358.
Anacardiaceæ	<i>Spondias mombin</i> L. <i>Kinim</i> , <i>Jobo.</i> 2352, 3002.
Sapindaceæ	<i>Matayba oppositifolia</i> (A. Rich.) Britton. <i>Zacuayum.</i> 2848.
Araliaceæ	<i>Didymopanax morototoni</i> (Aubl.) Dene. & Planch. <i>Guarumo de montaña.</i> 3068.
Verbenaceæ	<i>Vitex gaumeri</i> Greenm. <i>Yaxnic</i> , <i>Yaaxnic.</i> 3540.

#### TREES AND SHRUBS 4 TO 10 METERS IN HEIGHT:

Palmae	<i>Acrocomia mexicana</i> Karw. <i>Cocoyol</i> , <i>Supa.</i> 3205.
Moraceæ	<i>Ficus lundellii</i> Standl. <i>Amate</i> , <i>Copo.</i> 3249; <i>Aguilar</i> 210. <i>Cecropia</i> sp. <i>Ixcoochle</i> , <i>Guarumo.</i> 3006, 3016.
Urticaceæ	<i>Laportea mexicana</i> (Liebm.) Miq. <i>Laal</i> , <i>Ortiga.</i> 3104.
Polygonaceæ	<i>Coccoloba belizensis</i> Standl. 3463. <i>Coccoloba schiedeana</i> Lindau. <i>Cholop</i> , <i>Cholob.</i> 3340; <i>Aguilar</i> 275, 313.
Lauraceæ	<i>Nectandra membranacea</i> Griseb. <i>Laurel blanco.</i> 3348. <i>Phæbe mexicana</i> Meissn. (?). <i>Aguacatillo.</i> 2346.
Leguminosæ	<i>Acacia cookii</i> Safford (?). <i>Subin.</i> 3087. <i>Acacia costaricensis</i> Schenck. <i>Subin.</i> 2379, 2614.



- Acacia farnesiana* (L.) Willd. Aguilar 382.  
*Acacia spadicigera* Schl. & Cham. Subin. 2240.  
*Diphysa carthagenensis* Jacq. Zuzoc, Guachipilin. 2450, 2460, 2974; Aguilar 422.  
*Erythrina americana* Mill. Pita del monte. 3702.  
*Inga leptoloba* Schlecht. Bitze, Paternilla. 2105, 2555; Aguilar 419.  
*Pithecolobium guatemalense* (Britt. & Rose) Standl. Yaxek, Tinta blanca. 2532, 3021.  
*Pithecolobium tortum* Mart. Yaxek. 3656.  
*Swartzia lundellii* Standl. 3613.  
 Meliaceæ *Trichilia hirta* L. Cedrillo. 2261.  
*Trichilia trifolia* L. 2335.  
 Simarubaceæ *Simaruba glauca* DC. Pasak, Chapascuapul, Flor de pasar, Zapatero. 2185, 2234; Aguilar 363.  
 Burseraceæ *Protium copal* (Schl. & Cham.) Engl. 2262.  
 Euphorbiaceæ *Acalypha lancetillæ* Standl. Kadillo. 3554.  
*Alchornea latifolia* Sw. 2574, 3083.  
*Bernardia interrupta* (Schlecht.) Muell. Arg. 3250, 3355.  
 Anacardiaceæ *Metopium brownei* (Jacq.) Urban. Chechem negra. 3063, 3534; Aguilar 335.  
 Sapindaceæ *Allophylus cominia* (L.) Sw. 2246, 2255; Aguilar 296.  
*Allophylus kinlochii* Standl. (?). Ikbatch, Chile chachalaca. 3555.  
*Cupania belizensis* Standl. 2443; Aguilar 218.  
*Cupania glabra* Sw. 2347.  
 Rhamnaceæ *Colubrina heteroneura* (Griseb.) Standl. Espina de clavo. 2218; Aguilar 89.  
 Bombacaceæ *Hampea trilobata* Standl. Belhi. Aguilar 324.  
 Dilleniaceæ *Curatella americana* L. Saha. 2266, 2573A.  
 Ternstroemiaceæ *Ternstroemia tepezapote* Schl. & Cham. Panool, Chique, Roble. 1653, 3036, 3046, 3541, 4883.  
 Cochlospermaceæ *Cochlospermum vitifolium* (Willd.) Spreng. Pochote. 2122.  
 Flacourtiaceæ *Casearia aculeata* Jacq. Pullun. 3361, 3455, 3638, 4305; Aguilar 29, 180, 303.  
*Casearia nitida* (L.) Jacq. Aguilar 229.  
*Lætia thamnia* L. Bakelak. 3353, 3532.  
*Prockia crucis* L. 3722.  
*Zuelania guidonia* (Sw.) Britt. & Millsp. Tamay. 2338, 3336, 3545 (?).  
 Myrtaceæ *Eugenia vincentina* Krug & Urban. Jolteillo. 3631, 3746.  
 Melastomataceæ *Miconia argentea* (Sw.) DC. Jolte, Tolle. 1661, 2430, 2536, 3347; Aguilar 348, 368.  
*Miconia impetiolepis* (Sw.) D. Don. 1660.  
 Araliaceæ *Oreopanax guatemalense* (Lem.) Dene. & Planch. Pomoche. 3465.  
 Ebenaceæ *Diospyros yucatanensis* Lundell. 3560.  
 Sapotaceæ *Chrysophyllum oliviforme* L. (?). Zikiya. 3501.  
*Dipholis salicifolia* (L.) A. DC. Zitzya. 3354.  
 Apocynaceæ *Tabernaemontana chrysocarpa* Blake. Cojon de caballo, Lecheso. 2354, 2897, 3106, 3278, 3468, 4868.  
 Verbenaceæ *Lippia myriocephala* Schl. & Cham. Tah, Maste. 2119, 2599; Aguilar 394.  
 Rubiaceæ *Guettarda combsii* Urban. Texpac, Textop. 2970, 3509, 4431; Aguilar 114.

## SHRUBS LESS THAN 4 METERS IN HEIGHT:

- Cycadaceæ *Zamia furfuracea* L. f. 3252.  
 Piperaceæ *Piper multinervium* Mart. & Gal. 3008.  
*Piper plumbeicolor* Trel.  
*Piper emancipationis* Trel.  
 Olacaceæ *Schæffia schreberi* Gmel. Limoncillo. 2326.  
*Ximenia americana* L. Saaxnic. 2975.  
 Rosaceæ *Hirtella racemosa* Lam. Aceituno colorado. 2217, 3049; Aguilar 190.  
 Leguminosæ *Æschynomene fascicularis* Schl. & Cham. 3413.  
*Bauhinia unguolata* L. Pata de vaca. 2437, 2560; Aguilar 342.

- Calliandra houstoniana* (Mill.) Standl. 2977.  
*Cassia emarginata* L. 2616.  
*Cassia undulata* Benth. 2954.  
*Indigofera suffruticosa* L. Añil de piedra. Aguilar 211.  
*Mimosa albida* Humb. & Bonpl. 2269, 2436; Aguilar 398.  
*Parosela vulneraria* (Erst.) Rydb. Zulcate. Aguilar 388.  
 Erythroxylaceæ *Erythroxylon areolatum* L. Limoncillo. 2182, 2250, 3366, 3472, 4869.  
 Malpighiaceæ *Byrsonima crassifolia* (L.) HBK. Chi, Nanze. 2348, 3007.  
*Malpighia puniceifolia* L. Tocab. 3356, 3612, 3732; Aguilar 261.  
 Malvaceæ *Malvaviscus brevibracteatus* E. G. Baker. Tulipan. 2265.  
*Malvaviscus grandiflorus* HBK. Tulipancillo. Aguilar 87.  
 Sterculiaceæ *Helicteres guazumæfolia* HBK. 3464.  
 Hypericaceæ *Vismia ferruginea* HBK. Kuxupche, Achiotillo. 3064, 3094, 3247, 3327, 3404; Aguilar 126.  
 Flacourtiaceæ *Xylosma anisophylla* Standl. 2469.  
*Xylosma hemsleyana* Standl. (?). 2143, 2247.  
 Myrtaceæ *Eugenia capuli* (Schl. & Cham.) Berg. Chilonche, Escobillo. 2329, 2336, 2507; Aguilar 96.  
*Myrcia ærstediana* Berg. Aguilar 13, 159.  
 Melastomataceæ *Clidemia dependens* Don. 3038.  
*Clidemia serrulata* (Schlecht.) Triana. (?). 1652.  
*Conostegia zalapensis* (Bonpl.) Don. Pasita, Toltejiillo. 1654, 1658, 2186, 2245, 2558, 3208; Aguilar 424.  
*Miconia hondurensis* Donn. Sm. Aguilar 295.  
*Miconia ibaguensis* (Humb. & Bonpl.) Triana. 3037, 3454.  
*Mouriria parvifolia* Benth. Chicharillo. 2976; Aguilar 272.  
 Myrsinaceæ *Ardisia compressa* HBK. (?). 2264.  
*Parathesis obovata* Standl. Ixpanol, Ixpanpanjul. 3057, 3606; Aguilar 354.  
 Loganiaceæ *Buddleia americana* L. 3105.  
 Apocynaceæ *Rauwolfia canescens* L. var. *glabra* Mgf. 3467.  
*Thevetia ahouai* A. DC. Cojon de perro. 4062.  
 Boraginaceæ *Cordia gerascanthus* L. 3603.  
 Verbenaceæ *Callicarpa acuminata* HBK. 3027; Aguilar 63.  
*Clerodendron ligustrinum* (Jacq.) R. Br. Muste. Aguilar 353.  
*Cornutia latifolia* (HBK.) Moldenke. Chialche. Aguilar 54.  
*Cornutia pyramidata* L. var. *isthmica* Moldenke. 3450.  
 Solanaceæ *Solanum diversifolium* Schlecht. 2559; Aguilar 119.  
 Rubiaceæ *Alibertia edulis* (L. Rich.) A. Rich. Pichipche, Guayabillo. 3080, 3082, 3206; Aguilar 46.  
*Cephaelis tomentosa* (Aubl.) Vahl. Madre. 1647, 4888.  
*Guettarda elliptica* Sw. 3329.  
*Guettarda gaumeri* Standl. Zedi. Aguilar 312.  
*Hamelia patens* Jacq. 3103.  
*Machaonia acuminata* Humb. & Bonpl. Aguilar 11.  
*Palicourea galeottiana* Martens. Aguilar 306.  
*Palicourea guianensis* Aubl. Bitcul. 3460; Aguilar 302.  
*Psychotria horizontalis* Sw. 3563, 3629, 3726; Aguilar 260.  
*Psychotria pubescens* Sw. 3462.  
*Psychotria sessilifolia* Mart. & Gal. 2263.  
*Randia aculeata* L. 2224.  
*Randia albonervia* Brandege. Luchmaax. 3362.  
*Randia malacocarpa* Standl. 3474.  
*Randia monantha* Benth. (?). Luchmaax. 3003.  
*Rondeletia belizensis* Standl. Chakanche. 3210, 3352; Aguilar 28.  
 Compositæ *Clibadium arboreum* J. D. Smith. Aguilar 322.  
*Eupatorium ærstedianum* Benth. 3604.  
*Trixis radialis* (L.) Kuntze. 2103.  
*Vernonia aschenborniana* Schauer. 2114, 2226, 2561; Aguilar 355, 408.  
 Subscandent.  
*Vernonia tortuosa* (L.) Blake. 2110, 2572; Aguilar 383. Subscandent.

## LIANAS AND SCRAMBLERS:

- Connaraceæ *Cnestidium rufescens* Planch. *Uayumak*, *Bejuco colorado*. 2223, 2345, 3012, 3026, 3248, 3551, 4870; Aguilar 14, 299, 310.  
*Rourea glabra* HBK. *Uayumak*. 3011, 3010; Aguilar 300.
- Leguminosæ *Dalbergia glabra* (Mill.) Standl. *Kibix*, *Muc*. 2533; Aguilar 283, 385.  
*Machærium merrillii* Standl. 2399.
- Malpighiaceæ *Banisteria beecheyana* (Juss.) C. B. Rob. Aguilar 429.  
*Banisteria laurifolia* L. 3035.  
*Hiræa obovata* (HBK.) Ndzu. *Igchej*, *Bejuco mariposa blanca*. 3363, 3370; Aguilar 294, 328.  
*Tetrapteris schiedeana* Cham. & Schl. *Bejuco treach*. Aguilar 234.
- Polygalaceæ *Bredemeyera lucida* (Benth.) Benn. 2847.  
*Securidaca sylvestris* Schlecht. 2744.
- Sapindaceæ *Paullinia pinnata* L. 3531; Aguilar 248, 287.  
*Serjania atrolineata* Sauv. & Wright. 2115, 2334, 2365, 2366, 3550.  
*Serjania goniocarpa* Radlk. Aguilar 239.  
*Serjania mexicana* (L.) Willd. *Barbasco*. 2993, 3014, 3043, 3281.
- Rhamnaceæ *Gouania polygama* (Jacq.) Urban. *Onak*, *Onhak*. 2358, 3549; Aguilar 125, 345.  
*Sageretia elegans* (HBK.) Brongn. *Canak*. 3360; Aguilar 264.
- Vitaceæ *Cissus sicyoides* L. 2124.  
*Vitis tiliæfolia* Humb. & Bonpl. *Uva*. 3461.
- Dilleniaceæ *Davilla kunthii* St. Hil. *Sajab*. 2183, 2253, 2571; Aguilar 225, 339.  
*Tetracera mollis* Standl. *Bejuco saha*. 3412.  
*Tetracera volubilis* L. *Bejuco de cachicon*. 2260; Aguilar 226.
- Combretaceæ *Combretum farinosum* HBK. *Bejuco cepillo*. Aguilar 341, 420.
- Boraginaceæ *Cordia ferruginea* (Lam.) R. & S. Aguilar 86.  
*Tournefortia hirsutissima* L. 2104, 3396.  
*Tournefortia peruviana* Poir. 3720.
- Bignoniaceæ *Arrabidaea lundellii* Standl. Aguilar 267.  
*Lundia dicheilocalyx* Blake. (?). *Makalis*. 3447.
- Rubiaceæ *Chicococca alba* (L.) Hitchc. 2351.  
*Morinda yucatanensis* Greenm. 2569.

## SUFFRUTESCENT AND HERBACEOUS VINES AND SCRAMBLERS:

- Gramineæ *Lasiacis divaricata* (L.) Hitchc. *Tzenetcho*, *Carrizo*. 2249, 3548, 4882; Aguilar 19.  
*Olyra latifolia* L. *Zit*, *Carrizo*. 3610; Aguilar 47.
- Smilacaceæ *Smilax mollis* H. & B. *Ixcoke*, *Diente de venado*, *Diente de perro*. 3066.  
*Smilax spinosa* Mill. *Bejuquillo de hierro*, *Diente de perro*. 2259, 2270, 2337; Aguilar 257.
- Orchidaceæ *Vanilla fragrans* (Salisb.) Ames. *Vainilla*. Aguilar 164.
- Ranunculaceæ *Clematis dioica* L. *Zepit*, *Barba de viejo*. Aguilar 92, 212, 340.
- Menispermaceæ *Cissampelos pareira* L. *Bejuco la preñada*. 2111, 2257, 3636, 3737.
- Leguminosæ *Calopogonium brachycarpum* Benth. Aguilar 405.  
*Canavalia villosa* Benth. *Belencok*. Aguilar 228.  
*Centrosema virginianum* (L.) Benth. 2222, 2273, 2330, 2364, 2513.  
*Rhynchosia longeracemosa* Mart. & Gal. 2615; Aguilar 213.  
*Rhynchosia pyramidalis* (Lam.) Urban. 2184, 2228.
- Euphorbiaceæ *Dalechampia tiliifolia* Lam. 2570.
- Vitaceæ *Cissus rhombifolia* Vahl. Aguilar 181.  
*Cissus salutaris* HBK. 3453.
- Passifloraceæ *Passiflora biflora* Lam. 2271, 2272.  
*Passiflora coriacea* Juss. 2349, 2439.  
*Passiflora fœtida gossipiifolia* (Desv.) Mast. *Conbulvulo*. Aguilar 357.  
*Passiflora fœtida hastata* (Bert.) Mast. *Tujo*. 3357, 3498; Aguilar 2.  
*Passiflora fœtida lanuginosa* Killip. 2227.
- Apocynaceæ *Mandevilla subsagittata* (R. & P.) Woods. 2333, 2363.  
*Mesechites trifida* (Jacq.) Muell. Arg. 3469.  
*Urechites andrieuxii* Muell. Arg. 3445, 3533.

- Asclepiadaceæ *Metastelma schlechtendalii* Dene. 3562; Aguilar 124.  
 Convolvulaceæ *Vincetoxicum chrysanthum* (Greenm.) Standl. Iga bejuco. Aguilar 307.  
*Calonyction clavatum* Don. Luna morada. Aguilar 423.  
*Ipomæa trifida* (HBK.) Don. 3452.  
*Ipomæa tuxtlensis* House. Quiebracajeto. Aguilar 309.  
*Jacquemontia pentantha* (Jacq.) Don. Aguilar 94.  
*Operculina pectinata* House. 3491.  
*Rivea corymbosa* (L.) Hallier. Ixtaventun, Flor de Guadalupe. Aguilar 427.  
 Solanaceæ *Lycianthes variifolia* Standl. 2331; Aguilar 258.  
 Rubiaceæ *Diodia sarmentosa* Sw. 2187, 3050.  
 Compositæ *Bidens squarrosa* HBK. Aguilar 214, 231.  
*Eupatorium albicaule* Sch. Bip. Ixhotz. 2971, 3538, 3718; Aguilar 17.  
*Eupatorium morifolium* Mill. Chople. 2125, 2927, 3055.  
*Eupatorium odoratum* L. 2361; Aguilar 16.  
*Notoptera scabridula* Blake. Aguilar 297.  
*Perymenium peckii* Robinson. Aguilar 344.  
*Salmea scandens* (L.) DC. 2112.  
*Zexmenia frutescens* (Mill.) Blake. Sos negro. Aguilar 426.
- HERBS:
- Schizæaceæ *Lophidium elegans* (Vahl) Presl. 3096, 4873.  
 Polypodiaceæ *Adiantum villosum* L. 2442.  
*Dryopteris subtetragona* (Link) Maxon. Ramillas. 3059; Aguilar 7.  
 Gramineæ *Lithachne pauciflora* (Sw.) Beauv. 2328.  
*Oplismenus hirtellus* (L.) Beauv. 2357.  
*Panicum pulchellum* Raddi. 2120; Aguilar 185.  
*Setaria paniculifera* (Steud.) Fourn. Zacate camalote. Aguilar 153.  
 Cyperaceæ *Fimbristylis preslii* Kunth. 2340.  
*Scleria lithosperma* (L.) Sw. 3637; Aguilar 187.  
*Scleria melaleuca* Schl. & Cham. 2547, 3725; Aguilar 62.  
 Bromeliaceæ *Bromelia karatas* L. Cham, Piñuela. 3005. Large coarse perennial.  
 Commelinaceæ *Commelina elegans* HBK. Lil. Aguilar 79.  
 Musaceæ *Heliconia latispatha* Benth. Bijau. Aguilar 319.  
*Heliconia* sp. Platanillo. 3721.  
 Moraceæ *Dorstenia contrajerva* L. Contrayerba. Aguilar 250.  
 Amaranthaceæ *Iresine celosia* L. 2440.  
 Leguminosæ *Crotalaria pumila* Ortega. Chipilincillo. Aguilar 184.  
 Malvaceæ *Sida acuta* Burm. 2268.  
*Sida paniculata* L. Aguilar 369.  
 Melastomataceæ *Pterolepis trichotoma* (Rottb.) Cogn. Aguilar 238.  
 Solanaceæ *Solanum lanceifolium* Jacq. 3517.  
 Scrophulariaceæ *Bacopa procumbens* (Mill.) Greenm. 3724.  
 Acanthaceæ *Dicliptera mollis* M. & S. Salvina. Aguilar 417.  
 Rubiaceæ *Hemidiodia ocimifolia* (Willd.) Schum. 3698.  
 Compositæ *Calea urticifolia* (Mill.) DC. 2109.  
*Elephantopus mollis* HBK. 2251; Aguilar 97, 189.  
*Neurolæna lobata* (L.) R. Br. 2121.  
*Verbesina gigantoides* Robinson. Chulque. Aguilar 232.
- EPIPHYTES:
- Polypodiaceæ *Nephrolepis pendula* (Raddi) J. Sm. (?). 2258. On trunk of *Acrocomia mexicana*.  
 Bromeliaceæ *Tillandsia festucoides* Brongn. 3928; Aguilar 351.  
*Tillandsia juncea* LeC. 2470, 3959.  
*Tillandsia schiedeana* Steud. 3929.  
*Tillandsia utriculata* L. (?). 3022.  
 Araceæ *Philodendron lundellii* Bartlett. 2551, 3394. Succulent-stemmed root-climber.  
*Syngonium podophyllum* Schott. 2550.

## Orchidaceæ

- Epidendrum nocturnum* Jacq. 2598.  
*Epidendrum radiatum* Lindl. Aguilar 249.  
*Epidendrum stenopetalum* Hook. 2230, 2323, 2567.  
*Epidendrum strobiliferum* Rehb. f. 2597.  
*Jacquinilla globosa* Schltr. 2236, 2256.  
*Leochilus* sp. 2314.  
*Oncidium ascendens* Lindl. 2332; Aguilar 386.  
*Pleurothallis comayaguensis* Ames. 2235.  
*Pleurothallis marginata* Lindl. 2339; Aguilar 230.  
*Scaphyglottis livida* (Lindl.) Schltr. 2231.  
*Schomburgkia tibicinis* Batem. (?). Boxin. 3229.

## Moraceæ

- Ficus cookii* Standl. (?). 2267. Hemi-epiphyte.

## Cactaceæ

- Cereus grandiflorus* (L.) Mill. 3513.

## CROWN PARASITES:

## Loranthaceæ

- Oryctanthus cordifolius* (Presl.) Urban. 3478. Woody vine covering tree crowns.  
*Phoradendron gaumeri* Trel. 3395.  
*Phoradendron liberdadanum* Trel. 2401.  
*Psittacanthus calyculatus* (DC.) Don. Mata palo. Aguilar 384.  
*Struthanthus cassythoides* Millsp. 3527. Woody vine covering tree crowns.  
*Struthanthus orbicularis* (HBK.) Blume. Bejuco seca palo. Aguila 256. Woody vine covering tree crowns.

## FLATLAND HIGH FORESTS

As revealed by the transect, the larger wooded areas of the flatlands generally contain high mesophytic forest in their central areas. This forest does not appear to consist of relics of an earlier climax association, but to the contrary it probably represents a sub-climax stage in the secondary successional series.

Detailed studies in the area have led me to the conclusion that the sub-climax mesophytic forest has come into existence through the following process.

The development of the underground drainage system in the flatlands has resulted in the formation of numerous sinks, some with outlets, others (*aguadas*) holding water for long periods or continuously. These sinks, possibly because of more favorable edaphic conditions, have been the foci for the establishment of the fire-resistant invading vegetation (that of the *zucches* and marginal zone described on pages 110 and 134. Around them and also at the bases of the limestone hills, this vegetation became established over a long period and gradually spread into the grasslands. This invasion has probably been very slow with retrogression often taking place, yet it has proceeded. In the meantime the areas first colonized by the fire-resistant pioneers were invaded by taller growth, each stage of which has been less xerophytic and more mesophytic. This process has continued in certain areas until the invading vegetation surrounding sinks and hills has spread and fused with that of the adjoining sinks and hills. Thus there have come into existence forested flatland areas of mesophytic forest covering as much as several square miles.<sup>1</sup>

<sup>1</sup> Although some of the sinks are probably very ancient, antedating the earliest settlement of man, there is evidence indicating that many sinks have been formed quite recently. In Sabana San Francisco and Sabana Kaltó I found two sinks which had been formed within the last few years. Both were small, being about 3 meters in diameter and 5 meters in depth. Their sides were vertical walls of clay which had not been eroded. The recent formation of many of the sinks probably is one of the major factors now making reforestation possible.

One such area is Monte Chicbul (fig. 1) where three *aguadas*, numerous drained sinks, and several hills have all been incorporated in the forest through coalescence. These sinks and hills now play a minor rôle since mesophytic forest has become established, yet they formed the nuclei around which the invading species first became established.

The mesophytic forest is of considerable age; in some places, as in Monte Chicbul, it approaches in luxuriance the quasi-rain-forest. Most of the trees are evergreen, and large lianas are common.

The mesophytic forest reaches an average height of about 20 meters, with a few of the trees towering up as much as 30 meters. There are three layers, the top story consisting of the scattered giants, the middle or second story in which the dominants are characteristic, and the lower or first story. In the humid interior, there may be distinguished the tall shrub layer, the low shrub layer, and the floor layer. In the two latter, juveniles and seedlings are most prominent. Epiphytes and lianas may be divided into two types: (1) trunk forms of the humid lower layers of the forest and (2) crown forms of the upper more or less xerophytic layer.

The stand of the characteristic species varies considerably from place to place. Among the typical trees are the *zacuayum*, *Matayba oppositifolia*, the *kanxan*, *Terminalia excelsa*, the *kiixche*, *Zanthoxylum procerum*, *Ficus* spp., the *uapake*, *Dialium guianense*, the *mierda de gallina*, *Casearia javitensis*, the *chacah*, *Bursera simaruba*, the *caoba*, *Swietenia macrophylla*, and the *hobillo*, *Astronium graveolens*.

The *zacuayum*, *Matayba oppositifolia*, is generally the actual dominant in the vicinity of La Libertad, and the areas are accordingly known as *zacuayumales*. At Polol and in Monte Chimah (fig. 1) *corozales*, groves of the giant magnificent palms, the *kantutz*, *Scheelea lundellii*, and *tutz* or *corozo*, *Orbignya cohune*, are present. *Corozales* are generally characteristic of river banks. In the flatland high forest at Polol, where the *corozo* palms are absent, the giant *uapake*, *Dialium guianense*, appears to be the dominant tree, giving the *uapakal*.

The species collected in the flatland high forest areas are given in the systematic list which follows. The collection numbers are those of the writer, unless otherwise indicated.

#### SECOND- AND THIRD-STORY TREES:

Palmæ	<i>Orbignya cohune</i> (Mart.) Dahlgren. <i>Tutz, Corozo.</i> 3592. <i>Scheelea lundellii</i> Bartlett. <i>Kantutz, Corozo.</i> 3752.
Moraceæ	<i>Brosimum alicastrum</i> Sw. <i>Ramon.</i> <i>Ficus segovize</i> Miq. <i>Copo.</i> 3334.
Leguminosæ	<i>Cassia moschata</i> HBK. <i>Bocotillo, Cañafistula.</i> 3546; <i>Aguilar</i> 336. <i>Dialium guianense</i> (Aubl.) Steud. <i>Uapake.</i> 3449.
Rutaceæ	<i>Zanthoxylum procerum</i> Donn. Sm. <i>Kiixche, Choonte, Naranjillo.</i> 3376.
Meliaceæ	<i>Swietenia macrophylla</i> King. <i>Chacalte, Caoba.</i> 3552.
Burseraceæ	<i>Bursera simaruba</i> (L.) Sarg. <i>Chacah colorado.</i> 3650.
Vochysiaceæ	<i>Vochysia hondurensis</i> Sprague. <i>Sayuk, Palo bayo.</i> 3039, 3448.
Anacardiaceæ	<i>Astronium graveolens</i> Jacq. <i>Kulinzis, Hobillo.</i> 3095. <i>Mosquitoxylum jamaicense</i> Krug & Urban. <i>Kunte, Pasak macho.</i> 3543; <i>Aguilar</i> 318. <i>Spondias mombin</i> L. <i>Jobo.</i>
Sapindaceæ	<i>Matayba oppositifolia</i> (A. Rich.) Britton. <i>Zacuayum.</i> 3077; <i>Aguilar</i> 325, 370.

- Flacourtiaceæ *Casearia javitensis* HBK. *Utaaxcaax*, *Taixcaax*, *Mierda de gallina*.  
3015, 3081, 3456; Aguilar 278.  
Combretaceæ *Terminalia excelsa* Liebm. *Kanzan*, *Pucte*. 2916; Aguilar 349.  
Verbenaceæ *Vitex gaumeri* Greenm. *Yaxnic*.

## FIRST-STORY TREES:

- Annonaceæ *Xylopia frutescens* Aubl. 3086.  
Lauraceæ *Nectandra globosa* (Aubl.) Mez. *Sakalante*. 3344.  
Leguminosæ *Acacia cookii* Safford (?). *Subin*. 3087.  
*Acacia costaricensis* Schenck. *Subin colorado*. 3660.  
*Inga punctata* Willd. *Bitze*. 3090.  
*Sweetia panamensis* Benth. *Aguilar* 311.  
Meliaceæ *Trichilia ærstediana* C. DC. (?). *Tiricio*. 3343.  
*Guarea excelsa* HBK. (?). *Lobin*. *Aguilar* 255.  
Simarubaceæ *Simaruba glauca* DC. *Pasak*.  
Burseraceæ *Protium copal* (Schl. & Cham.) Engler. *Copal*.  
Anacardiaceæ *Metopium brownei* (Jacq.) Urban. *Chechem negra*.  
Tiliaceæ *Luehea speciosa* Willd. *Kaaskat*. 3542.  
Clusiaceæ *Rheedia edulis* (Seem.) Triana & Planch. *Palo bayo*. 3398.  
Flacourtiaceæ *Lætia thamnina* L. *Bakelak*.  
*Zuelania guidonia* (Sw.) Britt. & Millsp. *Tamay*. 3091.  
Myrtaceæ *Calyptanthus chytaculia* (L.) Sw. *Jolteillo*. 3378.  
Symplocaceæ *Symplocos martinicensis* Jacq. 3571.  
Apocynaceæ *Stemmadenia grandiflora* (Jacq.) Miers. *Huevo de caballo*.  
Rubiaceæ *Guettarda combsii* Urban. *Textop*. 3092.

## SHRUBS AND TREELETS:

- Cycadaceæ *Zamia furfuracea* L. f.  
Palmae *Chamædorea* sp. *Aguilar* 254.  
Piperaceæ *Piper discolor* Trel. 2565, 4886.  
*Piper emancipationis* Trel. 3658.  
*Piper yucatanense* C. DC. 3657.  
Capparidaceæ *Capparis stenophylla* Standl. 3443.  
Rosaceæ *Hirtella racemosa* Lam. *Aceituno colorado*. 3079.  
Myrtaceæ *Eugenia capuli* (Schl. & Cham.) Berg. *Chilonche*.  
Melastomataceæ *Mouriria parvifolia* Benth. *Chicharillo*. 3078, 3471.  
Apocynaceæ *Thevetia ahouai* A. DC. *Cojon de perro*.  
Rubiaceæ *Alibertia edulis* (L. Rich.) A. Rich. *Pichipche*, *Guayabillo*. 3342.  
*Cephaelis tomentosa* (Aubl.) Vahl. 3602.  
*Psychotria horizontalis* Sw. 3076, 3372.  
*Psychotria undata* Jacq. 3374.  
*Randia malacocarpa* Standl. *Chazin*. 3496.

## LIANAS AND SCRAMBLERS:

- Palmae *Desmoncus ferox* Bartlett. *Bayal*. 2646.  
Smilacaceæ *Smilax* sp. *Diente de perro*.  
Connaraceæ *Cnestidium rufescens* Planch. *Uayumak*, *Bejuco colorado*. 2542, 3371.  
Leguminosæ *Dalbergia glabra* (Mill.) Standl. *Kibix*. 3009.  
Malpighiaceæ *Banisteria laurifolia* L. 3544.  
Polygalaceæ *Securidaca diversifolia* (L.) Blake. *Bejuco anicillo*. *Aguilar* 374.  
Sapindaceæ *Allophylus kinlochii* Standl. (?). *Ikbatch*, *Chile chachalaca*. 3555.  
*Paullinia pinnata* L. 3379.  
Rhamnaceæ *Gouania polygama* (Jacq.) Urban. *Onak*. 3549.  
Dilleniaceæ *Tetracera mollis* Standl. (?). *Bejuco saha*.  
Apocynaceæ *Forsteronia viridescens* Blake. 2540.  
Bignoniaceæ *Lundia dicheilocalyx* Blake. *Lux*. *Aguilar* 259.

## HERBACEOUS VINES:

- Schizæaceæ *Lygodium polymorphum* (Cav.) HBK. 2506, 2535.  
Leguminosæ *Galactia belizensis* Standl. 3346.



## HERBS:

Schizæaceæ	<i>Lophidium elegans</i> (Vahl) Presl. 3096.
Polypodiaceæ	<i>Polypodium pectinatum</i> L. 3378A, 4707.
Selaginellaceæ	<i>Selaginella</i> sp. 3377.
Gramineæ	<i>Olyra yucatanæ</i> Chase. Carrizo. 3375.
	<i>Panicum pulchellum</i> Raddi. 2545.
Zingiberaceæ	<i>Costus spicatus</i> (Jacq.) Sw. Caña agria. Aguilar 289.
	<i>Costus</i> sp. Caña de Cristo. Aguilar 290.
Compositæ	<i>Pseudelephantopus spicatus</i> (Juss.) Rohr. Codillo, Lengua de vaca. 3457.

## EPIPHYTES:

Polypodiaceæ	<i>Polypodium phyllitidis</i> L. 2538.
Bromeliaceæ	<i>Æchmea bracteata</i> (Sw.) Griseb. 2553.
	<i>Androlepis skinneri</i> (C. Koch) Brongn. 2605.
	<i>Tillandsia festucoides</i> Brongn. 2562.
	<i>Tillandsia schiedeana</i> Steud. 2534.
Araceæ	<i>Anthurium æmulum</i> Schott. Aguilar 338.
	<i>Monstera</i> sp. Kontix. 3609.
	<i>Philodendron lacerum</i> (Jacq.) Schott. (?). 2645.
	<i>Philodendron lundellii</i> Bartlett.
	<i>Synгонium podophyllum</i> Schott. (?). 2544, 2603, 3213, 3397.
Orchidaceæ	<i>Epidendrum cochleatum</i> L. 2577.
	<i>Epidendrum isomerum</i> Schltr. 2539.
	<i>Gongora quinquenervis</i> Ruiz & Pav. Aguilar 372.
	<i>Maxillaria friedrichsthalii</i> Rehb. f. Aguilar 99.
	<i>Stanhopea</i> sp. 3103.
	<i>Stelis rubens</i> Schltr. var. <i>oxypetala</i> (Schltr.) Ames. Aguilar 291.
	<i>Trigonidium egertonianum</i> Batem. 2566.
Piperaceæ	<i>Peperomia chicbulana</i> Trel. 3099.
	<i>Peperomia lundellii</i> Trel. 3338.
	<i>Peperomia pololensis</i> Trel. 3040, 3100, 3102.

*Milpas*<sup>1</sup>

Practically all of the villagers of La Libertad make their *milpas* in the forested *rendzina* soil region south of the savanna country. However, a few *milpas* are located in the flatland high forest area at Polol. The agriculturists of Cimarron have their clearings in the clay flatlands of that locality.

Felling in the *milpas* had been almost completed at the time of our arrival late in March; firing took place in May. Plates 4 and 5 give views of *milpas* at Santa Teresa on the Subin River (southern Petén) and at San Andres in Northern Petén. Plate 5 shows clearings at Santa Teresa and San Andres made in *guarumales*, young secondary bush characterized by the fast-growing soft-wood tree known to the natives as *guarumo* (*Cecropia*). Note the absence of large trunks and branches in those sites as compared with the clearing in old forest at Santa Teresa (Plate 4).

Previously, clearings for *milpas* had been made in Monte Chiebul and Monte Chimah, but cultivation in those areas had been given up, probably because of the difficulty of keeping out the cattle. The secondary vegetation of the abandoned *milpas* is discussed in the following pages. For a discussion of the general aspects of *milpa* agriculture in Petén refer to page 11.

<sup>1</sup> The *milpa* is called *col* by the Petén Maya. The weedy growth appearing in the *milpas* between the annual plantings is known as *catoc*.

We left Petén before the annual weedy growth had reached sufficient size to be studied, therefore no data are available concerning that aspect of *milpas* of the savanna country. Aguilar collected *Hibiscus abelmoschus* in a *milpa* during the wet season, but that is the only record from La Libertad.

#### ABANDONED *Milpas*

*Milpa* clearings in flatland high forest areas of the savanna country were found in Monte Chicbul, Monte Chimah, and at Polol. At the last place there are numerous fields as well as abandoned areas with several successional stages evident.

The *milpa* area in Monte Chicbul adjacent to Aguada Yaxnic (fig. 1) was abandoned in 1929. When I studied the secondary vegetation in May 1933 it averaged about 8 meters in height. In this area, then about 5 years old, the following species were most prominent.

#### TREES 5 TO 8 METERS IN HEIGHT:

Moraceæ	<i>Cecropia</i> sp. <i>Guarumo</i> .
Lauraceæ	<i>Nectandra</i> sp. <i>Sakalante</i> .
	<i>Nectandra</i> sp. <i>Laurel</i> .
Leguminosæ	<i>Inga punctata</i> Willd. (?). <i>Bitze</i> .
Flacourtiaceæ	<i>Casearia javitensis</i> HBK. <i>Mierda de gallina</i> .
	<i>Zuelania guidonia</i> (Sw.) Britt. & Millsp. <i>Tamay</i> .
Sapindaceæ	<i>Matayba oppositifolia</i> (A. Rich.) Britton. <i>Zacuayum</i> .
Araliaceæ	<i>Didymopanax morototoni</i> (Aubl.) Dene. <i>Guarumo de montana</i> .
Rubiaceæ	<i>Guettarda combsii</i> Urban. <i>Textop</i> .

#### SHRUBS 2 TO 5 METERS IN HEIGHT:

Piperaceæ	<i>Piper</i> spp. <i>Cordoncillo</i> .
Rosaceæ	<i>Hirtella racemosa</i> Lam. <i>Aceituno colorado</i> .
Leguminosæ	<i>Acacia</i> (3 bullhorn species). <i>Subin</i> .
Melastomataceæ	<i>Miconia argentea</i> (Sw.) DC. <i>Jolte</i> .
Rubiaceæ	<i>Alibertia edulis</i> (L. Rich.) A. Rich. <i>Guayabillo</i> .

The dominant species in this successional stage was the *bitze*, *Inga punctata* (?). However, *guarumo*, *laurel*, *zacuayum*, *mierda de gallina*, and the tall shrubby *cordoncillo* were all abundantly represented. The floor was entirely free of grasses and other weeds which typify the first phase after abandonment. These had been smothered by the taller rank secondary growth.

The rapid reestablishment of the mesophytic forest in that area is assured barring further disturbances. The edaphic conditions had not been sufficiently altered by the short period of cultivation to prevent reclamation by xeromesophytic and mesophytic species. The abandoned *milpa* was encircled by forest which probably prevented grassland fires from entering and destroying juveniles of the more mesophytic vegetation, thus the reforestation has been hastened. *Matayba oppositifolia* and *Casearia javitensis*, dominant and subdominant respectively in the adjacent high forest, will be the important trees in this plot also when the succession again reaches the sub-climax stage.

The secondary areas in Monte Chimah have been disturbed considerably by fire. Apparently the *milpa* clearings were made in a *corozal* as scattered relic trees of the *corozo* or *tutz* palm, *Orbignya cohune*, were present over a wide area.

The secondary growth was a dense thicket in some spots, while quite open in others. Where fire had not been too destructive, scattered trees were present.

Most of the species were leafless, hence I could obtain determinable material of only a few of the plants. A study of the Monte Chimah areas in the wet season would yield at least ten times the number of species listed below. The successional fire-disturbed vegetation often is quite complex and not at all easy to analyze even when all the plants are recognizable.

The following species were encountered in the Monte Chimah areas. The collection numbers are those of the writer, unless otherwise indicated.

#### TREES 5 TO 10 METERS IN HEIGHT:

Palmæ	<i>Orbignya cohune</i> (Mart.) Dahlgren. Corozo, Tutz. 3440.
Lauraceæ	<i>Misanteca</i> sp. 3435.
Rhamnaceæ	<i>Colubrina reclinata</i> (L'Hér.) Brongn. 3419.
Apocynaceæ	<i>Tabernamontana chrysocarpa</i> Blake. Cojon de caballo. 3433.
Boraginaceæ	<i>Cordia collococca</i> L. 3416.
Rubiaceæ	<i>Alseis yucatanensis</i> Standl. Dzon. 3434.

#### SHRUBS LESS THAN 5 METERS IN HEIGHT:

Nyctaginaceæ	<i>Neea choriophylla</i> Standl. 3427.
Leguminosæ	<i>Calliandra</i> sp. 3422.
Euphorbiaceæ	<i>Acalypha unibracteata</i> Muell. Arg. Tornillo. 3418.
	<i>Acalypha villosa</i> Jacq. 3429.
	<i>Phyllanthus nobilis</i> (L. f.) Muell. Arg. 3432.
Theophrastaceæ	<i>Jacquinia aurantiaca</i> Ait. Aguilar 332.
Sapotaceæ	<i>Chrysophyllum oliviforme</i> L. Zikiya.
Rubiaceæ	<i>Psychotria flava</i> Crst. 3437.
	<i>Randia malacocarpa</i> Standl. Chaxin. 3417.

#### WOODY AND SUFFRUTESCENT VINES:

Menispermaceæ	<i>Cissampelos pareira</i> L. Hierba estrella de la prenatala.
Leguminosæ	<i>Bauhinia glabra</i> Jacq.
Euphorbiaceæ	<i>Dalechampia panamensis</i> Pax. & Hoffm. 3438.
Vitaceæ	<i>Ampelocissus erdwendbergii</i> Planch. Bejuco de uva. 3425.
Verbenaceæ	<i>Petrea volubilis</i> L. 3431.
Bignoniaceæ	<i>Saldanhaea costaricensis</i> Kranzl. 3436.

#### WOODY SCRAMBLERS:

Palmæ	<i>Desmoncus ferox</i> Bartlett. Bayal. 3421.
Sterculiaceæ	<i>Byttneria aculeata</i> Jacq. Zarsahueca.
Boraginaceæ	<i>Tournefortia hispidissima</i> L. Aguilar 49.
	<i>Tournefortia umbellata</i> HBK. (?). Zarahu. Aguilar 148. A sub-scandent shrub which may be a new species according to Dr. I. M. Johnston.

#### HERBS:

Gramineæ	<i>Panicum bartlettii</i> Swallen. Aguilar 378.
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In the more open areas, grasses, all in sterile condition, covered the floor.

The *corozo* palm may become dominant if fires do not completely destroy the relic trees still scattered through the areas.

No detailed studies were made of the abandoned *milpas* at Polol. However, two successional phases of the secondary vegetation were recognized. Rotation from *milpa* to *acahual* to *milpa* has continued in the area over a period of at least twenty years.

One of the early successional phases is the *guarumal* in which the *guarumo*, *Cecropia* sp., dominates. In a much older phase, the following species were in evidence. The collection numbers are those of the writer.

TREES 8 TO 15 METERS IN HEIGHT:

Moraceæ	<i>Cecropia</i> sp. <i>Guarumo</i> .
Rhamnaceæ	<i>Colubrina reclinata</i> (L'Hér.) Brongn. 3760.
Apocynaceæ	<i>Stemmadenia grandiflora</i> (Jacq.) Miers. <i>Huevo de caballo</i> . 3444.
Rubiaceæ	<i>Alseis yucatanensis</i> Standl. <i>Dzon</i> . 3758.

SHRUBS LESS THAN 5 METERS IN HEIGHT:

Capparidaceæ	<i>Capparis stenophylla</i> Standl.
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FLOOR HERB:

Gramineæ	<i>Axonopus compressus</i> (Sw.) Beauv. 3762.
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Probably the most complicated phase of the ecological problem in the tropics concerns the secondary successional stages in areas which normally support climax vegetation. The successions appear to vary according to the state of the area on which they are initiated, *i.e.* inhabited clearings, *zacatales*, *milpas*, grasslands (as in the La Libertad region), etc. Where retrogression to deflected climax grasslands has occurred as in central Petén, almost an entirely new floristic assemblage of fire-resistant species must become established in the marginal areas before invasion can proceed.

In regions subject to fire destruction, the greater the degree of retrogression of the vegetation the greater will be the percentage of xerophytic fire-resistant species in the initial successional stages. Retrogression from fire destruction, grazing, long-continued occupation of the land by man, and probably other causes may result in xerophytic vegetation in a humid rain-forest area, and the xerophytic vegetation will remain as long as conditions persist which brought it into existence.

In edaphic climax areas, secondary successional stages are almost as complicated as in climatic climax areas. Successional stages in cleared edaphic areas are little known. My observations at Tuxpeña were the first made in the Maya country (Lundell, 1934).

To obtain scientifically accurate data on the problem of secondary successional stages, the areas studied must be continuously watched in order that all the stages may be recorded. Climatic data, edaphic data, as well as the influence of man and fire, must be taken into full consideration. Only through residence in the area or by periodic observations by competent botanists can accurate data on this important question be obtained. Field stations such as the one at Barro Colorado Island in the Panama Canal Zone will be logical places for such studies to be undertaken in the tropics.

Several centuries at least appear necessary for the climatic climax vegetation to become reestablished, so that no single investigator can solve the problem in a lifetime. Interpretation of successional stages now encountered probably will continue to be the chief source of data. Such interpretation is of great value,

yet as in the case of most *a priori* observations, the data are subject to qualifications to say the least. The time element involved is often beyond interpretation.

Dendrochronology may contribute much to solving the problem. The determination of the ages of successional stages by annual ring counts is a possibility now being investigated by the writer. Of the trees so far examined for annual rings, *Cedrela mexicana* appears most promising. It is a species appearing in abandoned clearings, persisting through the stages of reforestation, and surviving in advanced forest.

#### VEGETATION OF THE LIMESTONE HILLS, VALLEYS, AND MOUNDS

The limestone hills and valleys comprise the second of the two major physiological areas of the savanna country. The topography, *rendzina* soils, and calciphile vegetation distinguish this major area from the deep clay flatlands.

The limestone hills are domes of resistant rock with steep slopes and rounded caps (Plate 37). They form low irregular ranges rising not more than 80 meters above the flatland plains.

Although the limestone favors very vigorous plant growth, there are a few denuded hills (Plate 23, fig. 2). This may be accounted for by fire destruction. In the spring of 1933 ground fires swept through the forest on nearly all the hills and wrought much destruction (Plate 23, fig. 1). Repeated occurrences of these fires undoubtedly account for the deforestation of hills in certain localities. However, reforestation under the influence of the lime is much more rapid than in the deep clay flatlands, and denuded hills probably will become wooded again in a comparatively short time.

The valleys between the hills are generally narrow. Some have fairly deep clay soils, others only a thin mantle similar to that on the hills. When the valleys serve as drainage ways for the adjacent hills, then the limestone is often exposed. Even where the valley soils are of some depth, the influence of the lime is apparently a great factor.

On the basis of topographic and floristic differences, the hills and limestone valleys may be subdivided into three ecological zones: (1) hill caps, (2) hill slopes, and (3) limestone valleys. The hills deforested by fire and the man-made limestone mounds in Chakantun (fig. 1) have a similar vegetative covering, and may be treated together.

#### HILL CAPS

The hill caps are small rounded gently sloping areas, seldom more than 50 meters in width, yet their vegetation is distinctive. The caps are exposed to drying winds which greatly influence the flora. Also, the habitat is probably drier than the slopes and valleys. As a result the vegetation is an open, somewhat xerophytic type.

The usual association of the zone is typified by low trees of *Clusia flava*, *Protium copal*, *Oreopanax guatemalense*, *Rondeletia belizensis*, and *Bursera simaruba*.

In this tree assemblage, epiphytes are very prominent. Of the 76 species collected on the hill caps, 33 per cent were epiphytes, and the greatest numbers of these epiphytes were encountered in the association where *Clusia flava* was the key species.

Some hill caps support taller open forest. On one I found *Ficus lundellii*, *Clusia flava*, *Metopium brownei*, *Neea psychotrioides*, *Torrubia petenensis*, *Dipholis salicifolia*, *Cufodontia lundelliana*, and *Tabebuia chrysantha*, trees 6 to 15 meters in height. Another hill cap had *Bombax ellipticum*, *Protium copal*, *Clusia flava*, *Zanthoxylum procerum*, *Albizzia idiopoda*, *Gilbertia concinna*, *Astronium fraxinifolium*, and the thorny slender palm, *Cryosophila argentea*, as prominent species. On the same hill *Zamia furfuracea* was common.

On one hill cap, ferns, aroids, bromelioids, and a species of *Peperomia* grew profusely on top of and in the crevices of exposed limestone walls. This assemblage of species included the ferns *Asplenium auritum*, *A. formosum*, *Anemia adiantifolia*, *A. speciosa*, and *Polypodium plumula*, the bromelioid, *Pitcairnia recurvata*, which grew here in abundance, the coarse aroid, *Anthurium tetragonum* var. *yucatanense*, a root-climbing species of *Philodendron*, and the succulent-leaved *Peperomia petenensis* which formed a solid cover over small areas. These plants grew in the shade of trees and shrubs, among which were *Ficus lundellii*, *Clusia flava*, *Bursera simaruba*, *Chamædorea* spp., and *Bunchosia swartziana* var. *yucatanensis*.

The giant liana, *Gymnopodium floribundum*, completely covered another hill cap, forming a mass of intertwined growth through which it was difficult to chop a trail.

Where fires had wrought havoc with the forest growth, almost pure stands of the *chechem negra*, *Metopium brownei*, were found. Such stands are locally designated as *chechemales*.

The hill caps in general are characterized by scrubby, gnarled, somewhat xerophytic growth with *Clusia flava* as the typical tree species. Some of the trees and shrubs are deciduous, others are apparently evergreen. Epiphytes are more prominent, both in species and number of individuals, than in any other habitat of the savanna country.

All the species encountered in the hill cap zone are given in the following systematic list. The collection numbers are those of the writer, unless otherwise indicated.

## TREES:

Moraceæ	<i>Ficus lundellii</i> Standl. 2922, 3406.
Nyctaginaceæ	<i>Neea psychotrioides</i> Donn. Sm. 2833, 3001, 3405.
	<i>Torrubia petenensis</i> Lundell. 3518.
Rosaceæ	<i>Hirtella americana</i> L. Aceituno peludo. 2099; Aguilar 329.
Leguminosæ	<i>Albizzia idiopoda</i> (Blake) Britt. & Rose. 2876.
	<i>Gliricidia sepium</i> (Jacq.) Steud. Kante. 2852, 2885.
Rutaceæ	<i>Zanthoxylum procerum</i> Donn. Sm. Kixche, Choonte, Naranjillo. 2874.
Burseraceæ	<i>Bursera simaruba</i> (L.) Sarg. Chacah. 2857.
	<i>Protium copal</i> (Schl. & Cham.) Engler. Pom, Copal. 2871.

- Anacardiaceæ *Astronium fraxinifolium* Schott. *Kulinzis, Hobillo.* 2881.  
 Hippocrateaceæ *Metopium brownei* (Jacq.) Urban. *Chechem negra.* 3534.  
*Hippocratea* sp. *Bek, Roble.* 2884.  
*Hippocratea subintegra* Blake. *Zipiche.* 2966.  
 Bombacaceæ *Bombax ellipticum* HBK. *Chulte, Amapola, Ceiba.* 2872; Aguilar 282.  
*Ceiba æsculifolia* (HBK.) Britt. & Baker. *Kinin.* 3569.  
 Clusiaceæ *Clusia flava* Jacq. *Hoja de tortilla.* 2853.  
*Clusia* sp. *Sello.* Aguilar 241.  
 Flacourtiaceæ *Lætia thamnina* L. *Bakelak.* 2879; Aguilar 284.  
 Araliaceæ *Gilibertia concinna* Standl. *Xup.* 2880.  
*Oreopanax guatemalense* (Lem.) Dcne. & Planch. *Pomoche.* 2965.  
 Sapotaceæ *Dipholis salicifolia* (L.) A. DC. *Zitzya.* 3690.  
 Apocynaceæ *Cufodontia lundelliana* Woodson. 3408.  
 Bignoniaceæ *Tabebuia chrysantha* (Jacq.) Nichols. 3407.  
 Rubiaceæ *Guettarda combsii* Urban. *Texpac, Textop.*  
*Rondeletia belizensis* Standl. *Chakanche.* 2854.
- SHRUBS AND TREELETS:
- Cycadaceæ *Zamia furfuracea* L. f. 2886, 3580.  
 Palmæ *Chamædorea* sp. 2878.  
*Cryosophila argentea* Bartlett. *Akuum, Escoba.* 2887.  
 Leguminosæ *Calliandra* sp. 2870.  
 Malpighiaceæ *Bunchosia swartziana* Griseb. var. *yucatanensis* Ndzu. *Zipiche, Hoja del viento.* 2920, 3567, 3691; Aguilar 245.  
*Malpighia glabra* L. Aguilar 285.  
*Malpighia puniceifolia* L. 3568.  
 Ochnaceæ *Ouratea peckii* Riley. 2101, 2877.  
 Theophrastaceæ *Jacquinia aurantiaca* Ait. 3519.  
 Acanthaceæ *Aphelandra deppeana* Schl. & Cham. 3004.  
 Rubiaceæ *Psychotria granadensis* Benth. 2855.  
*Psychotria undata* Jacq. Aguilar 292.
- LIANAS:
- Smilacaceæ *Smilax mollis* H. & B. *Diente de perro.* 2858.  
 Polygonaceæ *Gymnopodium floribundum* Rolfe. 3516.  
 Leguminosæ *Dalbergia glabra* (Mill.) Standl. *Kibix.* 2882.  
 Polygalaceæ *Securidaca sylvestris* Schlecht. 2894.
- HERBS GROWING ON ROCKS AND IN CREVICES:
- Schizæaceæ *Anemia adiantifolia* (L.) Sw. *Culantrillo.* 2931; Aguilar 277.  
*Anemia speciosa* Presl. 2933.  
 Polypodiaceæ *Asplenium auritum* Sw. 2979.  
*Asplenium formosum* Willd. *Cola de quetzal.*  
*Polypodium plumula* H. & B. 2980.  
*Pitcairnia recurvata* (Scheidw.) C. Koch. 2921.  
 Bromeliaceæ *Anthurium tetragonum* Hook. var. *yucatanense* Engl. *Baatun.* 2873.  
 Araceæ *Brassia maculata* R. Br. 2637.  
 Orchidaceæ *Peperomia petenensis* Trel. 2129, 2939.  
 Piperaceæ
- EPIPHYTES:
- Polypodiaceæ *Polypodium palmeri* Maxon. *Chouak, Mutusay, Mimbire.* 2875, 2883.  
*Polypodium phyllitidis* L. 2624.  
 Bromeliaceæ *Catopsis aloides* (Ch. & Schdl.) Bak. 2633.  
*Catopsis bakeri* Mez. 2627.  
*Tillandsia bulbosa* Hook. 2628.  
*Tillandsia dasyliriifolia* Baker. 2630.  
*Tillandsia fasciculata* Sw. 2629, 3564.  
*Tillandsia festucoides* Brongn. 2837.  
*Tillandsia juncea* LeC. 2838.  
*Tillandsia pruinosa* Sw. 2626.  
*Vriesia gladioliflora* (Wendl.) Ant. 2631.  
 Araceæ *Philodendron smithii* Eng. 2929.



Orchidaceæ	<i>Bulbophyllum aristatum</i> (Rchb. f.) Hemsl. 2636.
	<i>Campylocentrum micranthum</i> Rolfe. 2127.
	<i>Epidendrum cochleatum</i> L. 2623.
	<i>Epidendrum diffusum</i> Sw. 2634.
	<i>Epidendrum strobiliferum</i> Rchb. f. 2128.
	<i>Maxillaria tenuifolia</i> Lindl. 2632, 2638.
	<i>Oncidium sphacelatum</i> Lindl. 2134, 2639.
	<i>Schomburgkia tibicinis</i> Batem. (?). Bozin. 3000.
	<i>Sobralia</i> sp. 2625.
	<i>Stelis ciliaris</i> Lindl. 2963 (?); Aguilar 230A.
	<i>Trigonidium egertonianum</i> Batem. 2635.
	<i>Peperomia polochicana</i> Trel. 2938.
Piperaceæ	
Cactaceæ	<i>Cereus grandiflorus</i> (L.) Mill. 3513.

## HILL SLOPES

The hill slopes resemble the hill caps to a considerable degree. The soil is a thin black mantle composed mostly of humus, a layer too thin to cover the larger roots of many of the trees. In general the vegetation is somewhat scrubby and xerophytic.

Because of the low growth, layering is not pronounced. Epiphytes are common, but not as prominent as on the hill caps. The majority of the species appear to be evergreen. The period of defoliation of most of the deciduous forms lasts only a few weeks at the most.

The association encountered oftenest in this zone contains *Hirtella americana*, *Protium copal*, *Plumeria acutifolia*, and *Swartzia lundellii* as the characteristic tree species. The dominant species on the hill slopes is the *aceituno peludo*, *Hirtella americana*. This calciphile tree is as typical of the zone as *Clusia flava* is of the hill caps. In April and May, *Plumeria acutifolia* strikingly stands out on the hill sides with its beautiful large white flowers. *Hirtella americana* and *Plumeria acutifolia* are common only on hill slopes, being almost exclusively limited to that zone. The same is almost as true of *Swartzia lundellii*. Although *Protium copal* is common in the habitat, the species has a greater range and is occasionally encountered in the flatlands; it is, however, primarily a tree of *rendzina* soils. Of interest is the fact that *Achras zapota* is present in this zone, although rare. The *Hirtella americana* association is probably one of the stages near the climatic climax. I do not consider any of the hill associations as climax because of the repeated disturbances caused by ground fires.

Occasionally a hill slope is encountered which supports tall forest as much as 15 meters in height. In one such instance I found the *chechem blanco*, *Sebastiania longicuspis*, forming almost a solid stand.

As on the hill caps, fire destruction of other forest growth apparently leads to the dominance of the fire-resistant *chechem negra*, *Metopium brownei*. Several hill slopes were *chechemales*.

Shrubs and lianas are quite prominent on hill slopes, as a perusal of the following systematic list will show. The perennial, *Scleria lithosperma*, was the most prominent herb apparent during the dry season. Epiphytes were chiefly crown forms.

The hills with scrubby vegetation are often referred to locally as *pedregales*. The term *pedregal*, freely translated, means an association on rocks. The term fits admirably, although it does not distinguish between the hill cap and hill slope zones which are sufficiently distinct ecologically to be separated. At the base of a hill on the open savanna side, the hill slope forest may intergrade into marginal forest or flatland high forest (see Plate 26). At the hill base leading into the limestone valley, the hill slope vegetation intergrades into the limestone valley forest.

All the species collected on the hill slopes are given in the following systematic list. The collection numbers are those of the writer, unless otherwise indicated.

## TREES:

Palmae	<i>Opsandra maya</i> Cook. 3759. On Polol ruins.
Polygonaceae	<i>Coccoloba schiedeana</i> Lindau (?). 3570.
Menispermaceae	<i>Hyperbaena nectandrifolia</i> Standl. Aguilar 244.
Lauraceae	<i>Misanteca campechiana</i> (Standl.) Lundell. Dzol. 3409. <i>Misanteca</i> sp. Zootzni. 2865.
Rosaceae	<i>Hirtella americana</i> L. 2435, 2859, 2956.
Leguminosae	<i>Swartzia lundellii</i> Standl. Buluche. 2958; Aguilar 293.
Rutaceae	<i>Zanthoxylum procerum</i> Donn. Sm. Kiixche, Choonte, Naranjillo. 3487.
Simarubaceae	<i>Alvaradoa amorphoides</i> Liebm. Cola de ardilla. Aguilar 235.
Burseraceae	<i>Bursera simaruba</i> (L.) Sarg. Chacah. 3650. <i>Protium copal</i> (Schl. & Cham.) Engl. Pom, Copal. 2957.
Euphorbiaceae	<i>Sebastiania longicuspis</i> Standl. Chechem blanco. 3520.
Anacardiaceae	<i>Metopium brownei</i> (Jacq.) Urban. Chechem negra. 3534.
Celastraceae	<i>Wimmeria concolor</i> Schl. & Cham. 2640.
Ebenaceae	<i>Diospyros</i> sp. Aguilar 321.
Sapotaceae	<i>Achras zapota</i> L. Ya, Zapote, Chicozapote.
Apocynaceae	<i>Plumeria acutifolia</i> Poir. Nicté del monte. 2955.

## SHRUBS AND TREELETS:

Palmae	<i>Cryosophila argentea</i> Bartlett. Akum, Escoba. 2887.
Annonaceae	<i>Malmea depressa</i> (Baill.) Fries. 2100, 2839.
Malpighiaceae	<i>Bunchosia lanceolata</i> Turcz. 3499, 3761. <i>Bunchosia swartziana</i> Griseb. var. <i>yucatanensis</i> Ndzu. Zipiche, Hoja del viento. 3488. <i>Malpighia puniceifolia</i> L. 3568.
Malvaceae	<i>Hibiscus sororius</i> L. f. San Antonio. Aguilar 273.
Myrtaceae	<i>Eugenia capuli</i> (Schl. & Cham.) Berg. Chilonche, Escobillo. 2117.
Theophrastaceae	<i>Jacquinia aurantiaca</i> Ait. 3565.
Rubiaceae	<i>Psychotria flava</i> Oerst. 3489.

## LIANAS AND SCRAMBLERS:

Leguminosae	<i>Dalbergia glabra</i> (Mill.) Standl. Kibix. 2905.
Malpighiaceae	<i>Tetrapteris schiedeana</i> Cham. & Schl. Aguilar 425.
Polygalaceae	<i>Securidaca sylvestris</i> Schlecht. 2894.
Dichapetalaceae	<i>Dichapetalum donnell-smithii</i> Engl. Aguilar 243.
Sterculiaceae	<i>Byttneria aculeata</i> Jacq. Zarsahuca. Aguilar 428.
Rubiaceae	<i>Morinda yucatanensis</i> Greenm. Bejuco piñoncillo. Aguilar 276. <i>Chiococca alba</i> (L.) Hitchc. Aguilar 316.

## HERBS:

Cyperaceae	<i>Scleria lithosperma</i> (L.) Sw. 3649.
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## EPIPHYTES:

Polypodiaceae	<i>Polypodium crassifolium</i> L. 2926.
Bromeliaceae	<i>Tillandsia bulbosa</i> Hook. 2932.

Araceæ	<i>Anthurium tetragonum</i> Hook. var. <i>yucatanense</i> Engl. Baatun. 2941.
Orchidaceæ	<i>Brassia maculata</i> R. Br. 2831.
	<i>Cranichis</i> sp. Aguilar 100.
	<i>Maxillaria crassifolia</i> (Ldl.) Rehb. f. 2999.
	<i>Oncidium pusillum</i> (L.) Rehb. f. 2992.
	<i>Sobralia decora</i> Batem. (?). 2961, 2962.
Piperaceæ	<i>Peperomia polochicana</i> Trel. 2938.

## LIMESTONE VALLEYS

The soils of the narrow limestone valleys are deeper than any encountered on the hills, yet they appear to be so shallow that the underlying limestone is a factor greatly influencing the vegetation. Less attention was given to the valleys than to any other zone in the savanna country and accordingly the data are scant.

In the sections not severely disturbed by fire, the limestone valley forest is quite luxuriant, more so than the flatland high forest. The growth is dense and layers are well developed. Some species are deciduous, others evergreen, so that the forest may be termed semi-deciduous. When fires are severe, nearly all trees lose their leaves, but that is an abnormal condition (Plate 38, fig. 2).

The outstanding feature of the forest of the limestone valleys is the presence of the large leguminous trees among which *Enterolobium cyclocarpum*, *Schizolobium parahybum*, and *Tipuana lundellii* are outstanding (Plate 38, fig. 1). Other giants are *Terminalia excelsa* and *Aspidosperma* sp. These five tower from 30 to 45 meters and are among the trees comprising the top or third-story layer of the forest. The giants are relatively rare, yet they are the key species to the floristic assemblage often encountered in the zone.

Second-story trees ranging in height from 15 to 30 meters include *Alseis yucatanensis*, *Sickingia salvadorensis*, *Lucuma campechiana*, and last, but not of least importance, the two palms, *Orbignya cohune* and *Scheelea lundellii*. The *Orbignya* forms groves in Monte Hiltun, Monte Chimah, and Monte Polol. In Monte Polol *corozales*, the *Scheelea* is prominent. The *corozal* association is quite permanent, and where it occurs it represents one of the most stable phases of the vegetation of the limestone valleys. *Corozales* are also found on the deep clay flatlands (p. 142).

The first-story trees of the valleys are numerous. However, only a few species were collected. The liliaceous *Dracæna petenensis*, a species reaching a height of 10 meters, forms a considerable grove in Monte Hiltun. Among other small trees ranging from about 5 to 15 meters in height are *Dipholis salicifolia*, *Trichilia montana*, and *Albizia idiopoda*.

Shrubs are prominent, with species of the Rubiaceæ and Piperaceæ most numerous in individuals. The slender thorny *escoba* palm, *Cryosophila argentea*, is quite common in many places (Plate 38, fig. 1).

The woody scrambler, *Arthrostylidium pittieri*, forms dense intertwined undergrowth thickets over wide areas (Plate 38, fig. 2). The shade-loving *Olyra yucatanica* is occasionally encountered. The small creeping herb, *Geophila herbacea*, carpets the floor in sections of Monte Hiltun. Epiphytes were not given especial

attention; however, where fire has not wrought havoc, they are an important feature of the vegetation. In a humid valley I collected the giant bromelioid, *Androlepis skinneri*. Root-climbing aroids are not uncommon.

Fire destruction in the valleys is unusually severe. Many of the taller trees were killed in the dry spring of 1933 (Plate 38, fig. 2). These fires have interfered with normal development of the vegetation and caused retrogression; therefore it is difficult to hazard a guess as to what the climatic climax vegetation would be. Today the characteristic species of the zone are the giant fire-resistant leguminous trees. Many local variations in dominance occur as might be expected, as fire destruction has led to successional vegetation.

The systematic list which follows includes all the species collected in the limestone valley zone. Further study would result in numerous additions. The collection numbers are those of the writer, unless otherwise indicated.

### THIRD-STORY TREES:

- |             |  |
|-------------|--|
| Leguminosæ  | <i>Enterolobium cyclocarpum</i> (Jacq.) Griseb. 3687.<br><i>Schizolobium parahybum</i> (Vell.) Blake. Kopte. 3074.<br><i>Tipuana lundellii</i> Standl. 2895. |
| Combretaceæ | <i>Terminalia excelsa</i> Liebm. Pucte, Kanxan. 2916.  |
| Apocynaceæ  | <i>Aspidosperma</i> sp. 3692.  |

### SECOND-STORY TREES:

- |           |  |
|-----------|--|
| Palmae    | <i>Orbignya cohune</i> (Mart.) Dahlgren. Tutz, Corozo. 3592.   |
| Sapotaceæ | <i>Lucuma campechiana</i> HBK. Zapotillo de montaña. 3618.   |
| Rubiaceæ  | <i>Alseis yucatanensis</i> Standl. Dzon. 3434.<br><i>Sickingia salvadorensis</i> (Standl.) Standl. Chacahuante, Chactemuch, Palo colorado. 3621. |

### FIRST-STORY TREES:

- |            |   |
|------------|---|
| Liliaceæ   | <i>Dracæna petenensis</i> Lundell. 3271.              |
| Lauraceæ   | <i>Misanteca</i> sp. 3435.                            |
| Leguminosæ | <i>Albizia idiopoda</i> (Blake) Britt. & Rose. 3616.  |
| Meliaceæ   | <i>Trichilia montana</i> HBK. Aguilar 1.              |
| Sapotaceæ  | <i>Dipholis salicifolia</i> (L.) A. DC. Zitzya. 3058. |

### SHRUBS:

- |                |  |
|----------------|--|
| Piperaceæ      | <i>Piper sempervirens</i> (Trel.) Lundell. 3500.<br><i>Piper emancipationis</i> Trel. var. <i>longum</i> Trel. Poochuyaa. 3052.              |
| Leguminosæ     | <i>Calliandra</i> sp. Mota, Chultejillo, Pato de cerdo. 2843; Aguilar 356.   |
| Euphorbiaceæ   | <i>Acalypha villosa</i> Jacq. 3600.  |
| Ochnaceæ       | <i>Ouratea peckii</i> Riley. 3410.   |
| Theophrastaceæ | <i>Jacquinia aurantiaca</i> Ait. 3251, 3411, 3633.   |
| Myrsinaceæ     | <i>Ardisia paschalis</i> Donn. Sm. Xilil. Aguilar 55.  |
| Rubiaceæ       | <i>Psychotria marginata</i> Sw. Ookan cimarron. 3584.<br><i>Psychotria pubescens</i> Sw. 3617.<br><i>Rudgea ceratopetala</i> Donn. Sm. 3585. |

### LIANAS:

- |             |  |
|-------------|--|
| Connaraceæ  | <i>Rourea glabra</i> HBK. Uayumak. 3051. |
| Bignoniaceæ | <i>Saldanhaea costaricensis</i> Kranzl.  |

### WOODY SCRAMBLERS:

- |          |  |
|----------|--|
| Gramineæ | <i>Arthrostylidium pittieri</i> Hack. Tzenet, Carrizo, Fisga. 3591; Aguilar 304. |
|----------|--|

## HERBS:

- |          |   |
|----------|---|
| Gramineæ | <i>Olyra yucatana</i> Chase. Carrizo. 3497, 3586.                         |
| Rubiaceæ | <i>Geophila herbacea</i> (Jacq.) Schum. Zapillo. 3495, 3590; Aguilar 147. |

## EPIPHYTES:

- |             |  |
|-------------|--|
| Bromeliaceæ | <i>Androlepis skinneri</i> (C. Koch) Brongn. 2986. |
| Araceæ      | <i>Anthurium æmulum</i> Schott. Okil. 2990, 3054.  |
|             | <i>Philodendron smithii</i> Engl. Okil. 2994.      |

## LIMESTONE MOUNDS AND DEFORESTED HILLS

The ruins of the Maya city of Chakantun (Lundell, 1934a) lie entirely exposed in the Sabana San Francisco (fig. 1). The numerous man-made mounds are piles of limestone blocks now partially covered with a thin mantle of black *rendzina* soil. Fires sweeping the grasslands also run over the mounds with the result that many are denuded or only partially wooded with scrubby growth (Lundell 1934a, Plate 1). A few are overgrown with dense stands of the fire-resistant *chechem negra*, *Metopium brownei*.

Collections on the denuded and partially wooded mounds are given in the systematic list which follows. Of the trees, all except *Acacia angustissima* and *Lysiloma desmostachys* are typical of the flora of the forested limestone hills. *Acacia angustissima* is an occasional tree of the open savanna. *Lysiloma desmostachys* appears to be a calciphile species quite rare in the savanna country.

Of the shrubs, only *Psychotria granadensis* was represented on the hills. However, the other shrub species given in the following systematic list are primarily calciphiles.

The herbaceous growth is largely that of the grasslands with several notable exceptions. *Tragia* spp., *Operculina ornithopoda*, *Lisianthus congestus*, *Schultesia lisianthoides*, *Russelia flavoviridis*, *Cirsium* spp., and *Tridax procumbens* were found in the savanna country only on the denuded limy mounds. It is probable that some of these appear in other habitats.

The epiphytes are those chiefly encountered in xerophytic habitats such as the marginal forest zone. The large orchid, *Cyrtopodium punctatum*, was collected only on a mound at Chakantun.

Few collections were made on the deforested limestone hills (Plate 23, fig. 2), but the examination of them revealed much the same assemblage of woody and herbaceous species as found on the denuded and partially wooded Chakantun mounds.

In the following list the collection numbers are those of the writer, unless otherwise indicated.

## TREES:

- |              |   |
|--------------|---|
| Moraceæ      | <i>Ficus lundellii</i> Standl. Copo. 2464.              |
| Leguminosæ   | <i>Acacia angustissima</i> (Mill.) Kuntze. 3510.        |
|              | <i>Lysiloma desmostachys</i> Benth. 2455.               |
| Burseraceæ   | <i>Protium copal</i> (Schl. & Cham.) Engl. Copal. 2481. |
| Anacardiaceæ | <i>Metopium brownei</i> (Jacq.) Urban. 2459.            |
| Clusiaceæ    | <i>Clusia flava</i> Jacq. Hoja de tortilla. 2463.       |

## SHRUBS:

- Leguminosæ *Cassia oxyphylla* Kunth. *Flor de muerto*. 2465; Aguilar 127.  
 Malpighiaceæ *Bunchosia swartziana* Griseb. var. *yucatanensis* Ndzu. 2474.  
 Myrsinaceæ *Parathesis obovata* Standl. *Ixpanol*. 2480.  
 Rubiaceæ *Psychotria granadensis* Benth. 2466, 3506.

## SUFRUTESCENT AND HERBACEOUS VINES:

- Lauraceæ *Cassytha filiformis* L. 3508. (Parasitic.)  
 Euphorbiaceæ *Tragia yucatanensis* Millsp. 3481.  
*Tragia* sp. *Pica pica*. Aguilar 274.  
 Convolvulaceæ *Operculina ornithopoda* (Robinson) House. 2477, 3504.

## HERBS:

- Gramineæ *Andropogon glomeratus* (Walt.) B.S.P. 3482.  
 Commelinaceæ *Commelina elegans* HBK. *Lil*. 3502.  
 Euphorbiaceæ *Euphorbia hyssopifolia* L. 3503.  
 Gentianaceæ *Lisianthus congestus* Standl. 2479.  
*Schultesia lisianthoides* (Griseb.) Benth. & Hook. 2130.  
 Labiatae *Hyptis pectinata* (L.) Poit. 2489.  
 Scrophulariaceæ *Russelia flavoviridis* Blake. 2457, 3507.  
 Compositæ *Cirsium chrismarii* (Klatt) Petrak. (?). 2462.  
*Cirsium mexicanum* DC. *Cardosanto macho*. Aguilar 347.  
*Tridax procumbens* L. 2454.

## EPIPHYTES:

- Polypodiaceæ *Polypodium palmeri* Maxon. *Chouak*. 2133.  
 Orchidaceæ *Cyrtopodium punctatum* (L.) Lindl. 2131.  
*Epidendrum strobiliferum* Rehb. f. 2142.  
*Pleurothallis comayaguensis* Ames. 2140.  
*Pleurothallis purpusii* Schltr. 2138.  
*Stelis ciliaris* Lindl. 2141.

The vegetation of the limy *rendzina* soil zones of the savanna country is closely related to that of similar zones in Northern Petén and elsewhere in the Yucatan Peninsula. Calciphile species predominate, some being exclusively limited to certain habitats.

The presence of *Achras zapota* on the limestone hills in the savanna country is an indication that the species might become established if fires were controlled, and dominate both the hills and narrow limestone valleys. It is a typical species of *rendzina* soils. With undisturbed conditions, *Achras zapota* might possibly become the dominant in the climatic climax forest; however, that probably never will take place as man's activities undoubtedly will continue to be the controlling factors in the savanna country. It is quite certain that *Achras zapota* would never become established in a dominant position on the deep clay flatlands. In a similar, but forested area, along Roaring Creek in south-central British Honduras, *Achras zapota* characterizes limestone hills, and giant trees such as *Achras chicle* typify the deep clay valley forest. For further discussion of the relationships of the flora refer to page 204.

#### ANNOTATED LIST OF THE SPECIES COLLECTED OR OBSERVED IN THE CENTRAL PETÉN SAVANNA COUNTRY

The following annotated list, containing approximately 835 species, includes all the collections of the writer in central Petén in 1932 and 1933, and the collections of Mercedes Aguilar H. through 1935. The studies to date have been con-

centrated on the area in the vicinity of La Libertad. Thorough exploration, in both wet and dry seasons, of the entire savanna country probably would almost double the number of species herein reported.

I take the opportunity to emphasize again that all my collections and ecological studies were made during six weeks in the dry season. The abundance and distribution picture is based on the limited observations of that short period. It is probable that many species which I designate as "of the marginal forest," "of hill caps," etc., will be found to have a much wider distribution through other habitats.

All common names of plants are those in use in the savanna country. Likewise the meager and incomplete notes on medicinal, food, and other plants of economic value are based on data from that particular locality.

#### SCHIZÆACEÆ

*Anemia adiantifolia* (L.) Sw. *Culantrillo*. La Libertad, *Lundell* 2931; *Aguilar* 277. Occasional in limestone crevices on hill caps.

*Anemia speciosa* Presl. La Libertad, *Lundell* 2933. Occasional in limestone crevices on hill caps.

*Lophidium elegans* (Vahl) Presl. La Libertad, *Lundell* 3096, 4873. A very striking perennial about 45 cm. high; occasional on floor of flatland forest.

*Lygodium polymorphum* (Cav.) HBK. La Libertad, *Lundell* 2506, 2535. Occasional slender vine of flatland high forest and marginal forest.

#### POLYPODIACEÆ

*Adiantopsis* sp. La Libertad, *Aguilar* 489.

*Adiantum tenerum* Sw. *Culantrillo*. La Libertad, *Aguilar* 120. Occasional on damp walls and in wells; used in domestic medicine.

*Adiantum villosum* L. La Libertad, *Lundell* 2442. Perennial, about 50 cm. high; collected along a fence row in marginal forest.

*Asplenium auritum* Sw. La Libertad, *Lundell* 2979. Occasional on shaded limestone rocks of hill caps.

*Asplenium cristatum* Lam. La Libertad, *Aguilar* 494.

*Asplenium formosum* Willd. *Cola de quetzal*. La Libertad, *Lundell* 3647. Occasional in limestone crevices on hill caps.

*Dryopteris subtrigona* (Link) Maxon. *Ramillas*. La Libertad, *Lundell* 3059; *Aguilar* 7. Occasional in the more humid parts of marginal forest.

*Nephrolepis biserrata* (Sw.) Schott. La Libertad, *Lundell* 2952. Common epiphytic fern with long pendent fronds. Collected in the village on the trunk of *Sabal mexicana*.

*Nephrolepis pendula* (Raddi) J. Sm. La Libertad, *Lundell* 2258, 2915. Common epiphyte on palm trunks; fronds exceptionally long and narrow. Collected on the trunk of *Sabal mexicana* in the village, and on *Acrocomia mexicana* in marginal forest.

*Polypodium astrolepis* Liebm. La Libertad, *Lundell* 2444. Small epiphyte, growing in crotch of tree in the village.

*Polypodium triseriale* Sw. La Libertad, *Lundell* 2951. Collected on trunk of *Sabal mexicana* in the village.

*Polypodium crassifolium* L. La Libertad, *Lundell* 2926. Large trunk epiphyte; collected on a hill slope in low forest; encountered only once in the vicinity of La Libertad.

*Polypodium palmeri* Maxon. *Chouak*, *Mutusal*, *Mimbre*. La Libertad, *Lundell* 2133, 2478, 2875, 2883. Very common small creeping epiphyte on trees in marginal and hill forest.

*Polypodium pectinatum* L. (?). La Libertad, *Lundell* 3378A, 4707. Common terrestrial plant on floor of flatland high forest and limestone valley forest.

*Polypodium phyllitidis* L. La Libertad, *Lundell* 2538, 2624. Occasional epiphyte of flatland high forest and hills.



*Polypodium plumula* H. & B. La Libertad, Lundell 2980. Occasional on limestone rocks of hill caps.

*Polypodium polypodioides* (L.) Watt. La Libertad, Lundell 2494, 3403. Common creeping epiphyte; collected on tree trunks within the village limits.

*Pteris pungens* Willd. La Libertad, Aguilar 440.

#### MARSILIACEÆ

*Marsilia berteroi* A. Br. La Libertad, Lundell 2579. A small aquatic; found only in the dry basin of Aguada Chicah.

#### SELAGINELLACEÆ

*Selaginella huehuetenangensis* Hieron. Doradilla. La Libertad, Aguilar 490.

*Selaginella* sp. La Libertad, Lundell 3377. Common on the floor of flatland high forest in Monte Chicbul.

#### CYCADACEÆ

*Zamia furfuracea* L. f. La Libertad, Lundell 2886, 3252, 3580. Common stemless palmlike plant; most abundant on the hills but also present in flatland forest. The large starchy roots are used to poison rats.

#### PINACEÆ

*Cupressus benthami* Endl. Cypres. La Libertad, Lundell 3244. A tall shrub; planted for ornament.

*Pinus caribæa* Mor. Pino. La Libertad, Lundell 2846. A tree about 30 meters high; said to have been brought to La Libertad as a seedling from the pine lands near Poctun.

#### ALISMACEÆ

*Lophotocarpus guyanensis* (HBK.) J. G. Smith. Pan caliente. La Libertad, Aguilar 173. An aquatic herb; collected in Aguada El Progreso; apparently uncommon.

#### GRAMINEÆ

*Andropogon bicornis* L. Zacaton. La Libertad, Aguilar 268. A coarse perennial of the well-drained grasslands.

*Andropogon condensatus* HBK. La Libertad, Lundell 2374. Common tall perennial of well-drained grasslands.

*Andropogon glomeratus* (Walt.) B. S. P. La Libertad, Lundell 2482, 3482. Very common perennial of well-drained grasslands and denuded limestone mounds and hills.

*Andropogon leucostachyus* HBK. La Libertad, Lundell 2396. Common perennial of the well-drained grasslands.

*Andropogon selloanus* (Hack.) Hack. La Libertad, Lundell 3596. Common perennial; conspicuous in the swampy grasslands of Sabana Zotz.

*Arthrostylidium pittieri* Hack. Tzenet, Carrizo, Fisga. La Libertad, Lundell 3591; Aguilar 304. In Monte Hiltun the species forms a dense tangled undergrowth mass 3 to 5 meters high through which it is difficult to chop a path. The stems are used for fish spear poles.

*Axonopus compressus* (Sw.) Beauv. La Libertad, Lundell 3762. A small grass; much in evidence on the floor of the abandoned milpas at Polol.

*Axonopus purpusii* (Mez) Chase. La Libertad, Lundell 2302, 3594, 3639, 3678. A common small grass; very abundant at the beginning of the wet season. It occurs in both the well-drained and swampy grasslands.

*Bambusa vulgaris* Schrad. La Libertad, Lundell 2647. Planted for ornament.

*Cymbopogon citratus* (DC.) Stapf. Te de limon. La Libertad, Aguilar 42. A coarse cultivated perennial. Tea made from the leaves is said to have sudorific properties.

*Cynodon dactylon* (L.) Pers. La Libertad, Aguilar 66. A weedy perennial, forming a dense sod in the plaza and through the streets of the village.

*Dactyloctenium ægyptium* (L.) Richt. La Libertad, Aguilar 191, 205. A weedy annual; apparently common during the wet season.

*Digitaria sanguinalis* (L.) Scop. La Libertad, Aguilar 191A. A weed which is probably common during the wet season.

*Eleusine indica* (L.) Gaertn. La Libertad, Aguilar 65. A weedy annual, growing in the village.

*Eragrostis acutiflora* (HBK.) Nees. La Libertad, Lundell 3605. A small grass of the well-drained grasslands.

*Eragrostis ciliaris* (L.) R. Br. La Libertad, Lundell 2641; Aguilar 346. Common weedy annual, growing in the village.

*Eragrostis hypnoides* (Lam.) B. S. P. La Libertad, Lundell 2522. Small annual grass, completely covering the dry basin of Aguada Chachacluum during April and May.

*Hyparrhenia rufa* (Nees) Stapf. La Libertad, Aguilar 240. A large coarse grass, growing in fenced pastures.

*Lasiacis divaricata* (L.) Hitchc. Tzenetcho, Carrizo. La Libertad, Lundell 2249, 3548, 4882; Aguilar 19. Common slender, woody scrambler of the marginal forest.

*Leersia hexandra* Sw. La Libertad, Aguilar 168. Large tall grass; collected by Aguilar around Aguada El Progreso.

*Leptochloa filiformis* (Lam.) Beauv. La Libertad, Aguilar 203, 411. A common wet-season annual of inhabited areas.

*Leptocoryphium lanatum* (HBK.) Nees. Arrozillo, Pelillo. La Libertad, Lundell 2287, 2288, 2393, 3597, 3670. Very common perennial of well-drained and swampy grasslands.

*Lithachne pauciflora* (Sw.) Beauv. La Libertad, Lundell 2328. Rare small perennial of the marginal forest.

*Olyra latifolia* L. Zit, Carrizo. La Libertad, Lundell 3610; Aguilar 47. A somewhat woody scrambler 2 to 3 meters high; common in marginal forest.

*Olyra yucatana* Chase. Carrizo. La Libertad, Lundell 3375, 3497, 3586. A shade-loving perennial; occasional in flatland high forest and limestone valley forest.

*Oplismenus hirtellus* (L.) Beauv. La Libertad, Lundell 2357. A small grass; very abundant on the floor of marginal forest in some sections.

*Oryza sativa* L. Arroz. La Libertad, Lundell 3601. Cultivated to a limited extent. The yield is exceptionally high according to native reports.

*Panicum bartlettii* Swallen. La Libertad, Aguilar 378. A perennial of moist shaded areas.

*Panicum laxum* Sw. La Libertad, Lundell 2526; Aguilar 45A. A common annual around aguadas and in wet areas elsewhere.

*Panicum pilosum* Sw. La Libertad, Aguilar 8. A weedy perennial of inhabited areas.

*Panicum pulchellum* Raddi. La Libertad, Lundell 2120, 2545; Aguilar 185. A common floor grass; especially prominent in flatland forest.

*Paspalum conjugatum* Berg. La Libertad, Aguilar 141, 191B. A frequent weedy perennial of inhabited areas.

*Paspalum convexum* Humb. & Bonpl. La Libertad, Aguilar 317. A grass of the well-drained grasslands; apparently common during the wet season.

*Paspalum langei* (Fourn.) Nash. Grama. La Libertad, Lundell 3608, 3640, 3857. A slender perennial; common in well-drained grasslands and inhabited areas.

*Paspalum orbiculatum* Poir. La Libertad, Lundell 2527, 2585. A small grass, forming mats in basins of dry aguadas.

*Paspalum plicatulum* Michx. Zacate remolillo. La Libertad, Lundell 2305, 3561; Aguilar 45. A very common small perennial of the well-drained grasslands.

*Paspalum pulchellum* Kunth. La Libertad, Lundell 3583. One of the dominant perennials of the swampy grasslands in Sabana Zotz.

*Setaria geniculata* (Lam.) Beauv. Cola de gato. La Libertad, Lundell 2294; Aguilar 70. A very common perennial of the well-drained grasslands.

*Setaria paniculifera* (Steud.) Fourn. Zacate camalote. La Libertad, Aguilar 153. A coarse perennial; collected in burned marginal forest.

*Sorghum vulgare* Pers. Maicillo. La Libertad, Aguilar 35, 90. Cultivated in gardens and milpas. Aguilar states that its seeds are used "para hacer dulces y atolillos como maicena."

*Trachypogon angustifolius* (HBK.) Nees. Pajon. La Libertad, Lundell 2306, 2392, 2467, 3595. One of the dominant perennial grasses of the well-drained grasslands, swampy grasslands, and denuded mounds and hills. It is very conspicuous in the bobolar of Sabana Zotz.

*Tricholena rosea* Nees. Ilusion de seda. La Libertad, Aguilar 50. A slender perennial of well-drained grasslands and pastures; it is apparently quite common during the wet season.

*Tripsacum dactyloides* (L.) L. La Libertad, Lundell 2836.

*Zea mays* L. Ixiim, Maiz. Cultivated very extensively; it is the staple crop.

## CYPERACEÆ

*Cyperus articulatus* L. *Polol*. La Libertad, *Lundell* 3262. A tall coarse perennial, forming clumps in Aguada Chimah Pequeño.

*Cyperus cayennensis* (Lam.) Britton. La Libertad, *Aguilar* 197. Collected on the wet banks of Aguada El Progreso.

*Cyperus compressus* L. La Libertad, *Aguilar* 183. Collected in the village and on the banks of Aguada El Progreso.

*Cyperus dissitiflorus* Torr. La Libertad, *Aguilar* 77. An herb of the grasslands.

*Cyperus divergens* HBK. La Libertad, *Aguilar* 6. A slender tall herb of the grasslands.

*Cyperus globulosus* Aubl. La Libertad, *Lundell* 2486. A small perennial; much in evidence in the well-drained grasslands at the beginning of the rainy season.

*Cyperus luzulæ* (L.) Retz. La Libertad, *Lundell* 2523; *Aguilar* 9. A very common perennial of wet areas, especially open aguada banks.

*Dichromena ciliata* Vahl. *Jonquillo*. La Libertad, *Lundell* 2296; *Aguilar* 41. A common small perennial of the well-drained grasslands.

*Eleocharis interstincta* (Vahl) R. & S. *Polol*. La Libertad, *Lundell* 3263. The dominant aquatic sedge in Aguada Chimah Pequeño.

*Eleocharis* sp. *Pan caliente*. La Libertad, *Lundell* 3097. Small annual, growing in a dense mat on the muds in Aguada Yaxnic as the water receded during April and May.

*Eleocharis* sp. La Libertad, *Lundell* 2580. Small annual; quite abundant in dry aguada basins.

*Fimbristylis miliacea* (L.) Vahl. La Libertad, *Aguilar* 182. An annual of swampy grasslands.

*Fimbristylis monostachya* (L.) Hassk. *Pan caliente*. La Libertad, *Lundell* 3643. A common small filiform sedge of the well-drained grasslands.

*Fimbristylis preslii* Kunth. La Libertad, *Lundell* 2340. In marginal forest this species is occasionally found in abundance.

*Kyllinga pumila* Michx. La Libertad, *Lundell* 2498. An annual; collected in the dry basin of Aguada Chachacluum.

*Rynchospora aristata* Bœckl. La Libertad, *Lundell* 3599. One of the common perennials of the swampy grasslands in Sabana Zotz.

*Rynchospora cyperoides* (Sw.) Mart. La Libertad, *Aguilar* 71. An herb of well-drained grasslands; this species and a number of others were collected by Aguilar during the rainy season.

*Rynchospora globosa* (HBK.) R. & S. La Libertad, *Lundell* 3598. Another of the perennials abundant in the swampy grasslands of Sabana Zotz.

*Rynchospora* sp. La Libertad, *Lundell* 2518. Infrequent annual in the dry basin of Aguada Chachacluum.

*Rynchospora* sp. La Libertad, *Aguilar* 72. Collected by Aguilar in Sabana Popuctilum; apparently a wet-season annual.

*Scleria hirtella* Sw. La Libertad, *Lundell* 3593; *Aguilar* 109. Small occasional perennial of swampy grasslands.

*Scleria lithosperma* (L.) Sw. La Libertad, *Lundell* 3637, 3649; *Aguilar* 187. A common heliophobous perennial; much in evidence on the limestone hills and occasionally encountered on the floor of the marginal forest.

*Scleria melaleuca* Schl. & Cham. La Libertad, *Lundell* 2547, 3725; *Aguilar* 62. A common perennial on the floor of flatland forest.

*Scleria secans* (L.) Urban. *Zacate de huecht*. La Libertad, *Aguilar* 308. Apparently a perennial; collected in swampy grasslands.

*Stenophyllus hirtellus* (Schrud.) Standl. *Zacatillo*. La Libertad, *Aguilar* 43. An herb of the well-drained grasslands.

## PALMÆ

*Acrocomia mexicana* Karw. *Cocoyol*, *Supa*. La Libertad, *Lundell* 3205. Common large palm of grasslands and marginal forest. The fruits are occasionally eaten.

*Bactris* (?). *Match*. Monte Hiltun, *Lundell* 3588. Slender spiny palm 3 meters high; occasional in limestone valley forest.

*Chamædorea* spp. Several species were collected on the hills and in flatland forest.

*Cocos nucifera* L. *Coco*. La Libertad, *Lundell* 3215. Cultivated to a limited extent in the village, where it appears to thrive. All fruits produced are used locally.

*Cryosophila argentea* Bartlett. *Akuum*, *Escoba*. La Libertad, *Lundell* 2887. Common thorny undergrowth palm of the hills and limestone valleys.

*Desmoncus ferox* Bartlett. *Bayal*. La Libertad, *Lundell* 2646, 3421. Large spiny scrambler; occasionally encountered in the flatland forest.

*Opsiantha maya* Cook. La Libertad, *Lundell* 3759. Collected on the pyramid at Polol.

*Orbignya cohune* (Mart.) Dahlgren. *Tutz, Corozo*. La Libertad, *Lundell* 3440, 3592. Giant palm; common in hill slope, limestone valley, and flatland forest. Extensive groves occur in Monte Hiltun, Monte Chimah, and at Polol.

*Sabal mexicana* Mart. *Bonxaan, Huano de sombrero*. La Libertad, *Lundell* 3073. Cultivated to a limited extent; the young leaves are used to make hats.

*Scheelea lundellii* Bartlett. *Kantutz, Corozo*. La Libertad, *Lundell* 3752, type collection. A giant magnificent palm not unlike *Orbignya cohune* in general appearance, growing in the *corozales* at Polol with the latter species.

## BROMELIACEÆ

*Æchmea bracteata* (Sw.) Griseb. *Ixchu, Tinajero*. La Libertad, *Lundell* 2549, 2553, 2828. Common large tank epiphyte of all forested areas; very abundant in the village where it forms large masses in crotches of trees.

*Ananas comosus* (L.) Merrill. *Pina*. La Libertad, *Lundell* 3214. Cultivated in the village gardens and in special plots near the *milpas*.

*Androlepis skinneri* (C. Koch) Brongn. La Libertad, *Lundell* 2605, 2986. Giant epiphyte, growing in large masses on trunks and in crotches of trees; occasionally found on rocks. It is common in the limestone Santa Cruz valley near La Libertad, and may be encountered occasionally as an epiphyte in the humid flatland forest.

*Bromelia karatas* L. *Cham, Piñuela*. La Libertad, *Lundell* 3005. A common large, coarse, terrestrial plant; characteristic of marginal forest. Its acid fruits are highly prized and much sought by the natives.

*Catopsis aloides* (Cham. & Schl.) Baker. La Libertad, *Lundell* 2633. An occasional epiphyte of hill caps.

*Catopsis bakeri* Mez. La Libertad, *Lundell* 2627. A rare epiphyte of hill caps.

*Catopsis berteroniana* (Schult. f.) Mez. La Libertad, *Lundell* 2909. An epiphyte; found on trees in the grasslands and in the village.

*Pitcairnia recurvata* (Scheidw.) C. Koch. La Libertad, *Lundell* 2921. Abundant on rocks of certain hill caps.

*Tillandsia balbisiana* Schult. f. La Libertad, *Lundell* 2913. Collected on trees in the village.

*Tillandsia brachycaulos* Schl. La Libertad, *Lundell* 2908, 3753. A common epiphyte on trees in the village.

*Tillandsia bulbosa* Hook. La Libertad, *Lundell* 2628, 2932. A small epiphyte with inrolled leaves and bulblike base; common on some hills.

*Tillandsia dasyliriifolia* Baker. La Libertad, *Lundell* 2552, 2630, 2643, 2912. A common epiphyte on the hills, in the grasslands, and on trees in the village. The flower stalk is sometimes 1.5 meters tall.

*Tillandsia fasciculata* Sw. La Libertad, *Lundell* 2629, 2644, 2914, 3564. A coarse epiphyte of the hills, grasslands, and village.

*Tillandsia festucoides* Brongn. La Libertad, *Lundell* 2449, 2562, 2588, 2837, 2907, 3928; *Aguilar* 351. A common epiphyte in all habitats.

*Tillandsia juncea* LeC. La Libertad, *Lundell* 2470, 2838, 3959. An occasional epiphyte of the hills and marginal forest.

*Tillandsia polystachya* L. La Libertad, *Lundell* 2163, 2593, 2607, 2910. An occasional epiphyte on trees of the flatlands.

*Tillandsia pruinosa* Sw. La Libertad, *Lundell* 2626, 2911. Small epiphyte; collected on the hills and in the village; apparently uncommon.

*Tillandsia schiedeana* Steud. La Libertad, *Lundell* 2517, 2534, 2592, 3929. A small epiphyte; common on trees of the flatlands.

*Tillandsia utriculata* L. (?). La Libertad, *Lundell* 3022. An infrequent comparatively large epiphyte; collected in the marginal forest.

*Tillandsia valenzuelana* A. Rich. La Libertad, *Lundell* 2591. An epiphyte on trees in Poso Lagarto.

*Vriesia gladioliflora* (Wendl.) Ant. La Libertad, *Lundell* 2631. A large uncommon epiphyte; found on a hill cap in Monte Chicbul.

## ARACEÆ

*Anthurium æmulum* Schott. *Okil*. La Libertad, *Lundell* 2990, 3054; *Aguilar* 338. A frequent root-climbing epiphytic vine on tree trunks in humid limestone valley forest; occasionally encountered in flatland high forest.

*Anthurium tetragonum* Hook. var. *yucatanense* Engl. *Baatun*. La Libertad, *Lundell* 2873, 2941. Large coarse plant, growing on rocks on the hills; occasionally encountered as an epiphyte.

*Monstera* sp. *Kontix*. La Libertad, *Lundell* 3609. A large root-climbing epiphytic vine, completely covering tree trunks in wet forest; found only at Polol in the savanna country.

*Philodendron lacerum* (Jacq.) Schott. (?). La Libertad, *Lundell* 2645. A very large root-climbing epiphytic vine with broad pinnatifid leaves; not common around La Libertad.

*Philodendron lundellii* Bartlett. La Libertad, *Lundell* 2551, 3394. A fleshy root-climbing epiphytic vine; stems rough, characterized by crowded, minute, transverse ridges; leaves cordate, about 15 cm. in length, acute, entire. Common on trees in the marginal forest, rare elsewhere.

*Philodendron smithii* Engl. *Okil*. La Libertad, *Lundell* 2929, 2994. A coarse vine with large fleshy, deeply cordate leaves; found on rocks and as an epiphyte; common on the hills, infrequent elsewhere in the savanna region. The long aerial roots are called *takan*.

*Syngonium podophyllum* Schott. La Libertad, *Lundell* 2432, 2544, 2550, 2603, 3213, 3397, 3522. Common root-climbing epiphyte of all habitats. Several species probably are represented by the collections.

## COMMELINACEÆ

*Commelina elegans* HBK. La Libertad, *Lundell* 3502, 3694; *Aguilar* 79. A common fleshy perennial herb; collected in the village, on mounds in Chakantun, and in an abandoned *milpa*. *Aguilar* says that it is called *lil*.

*Commelina longicaulis* Jacq. La Libertad, *Lundell* 2587. A perennial herb; collected in the basin of Aguada Chicah.

## LILIACEÆ

*Asparagus plumosus* Baker. *Vela de novia*. La Libertad, *Lundell* 2372. Grown for ornament.

*Dracæna petenensis* Lundell. La Libertad, *Lundell* 3271, type collection. A massive tree 6 to 12 meters in height; trunk 20 to 30 cm. in diameter, expanded at base to a diameter of 70 to 90 cm.; bark corky, thin, with irregular, shallow, somewhat narrow fissures, and few irregular sharp, low ridges, mottled gray and tan, becoming irregularly gray, tan, and red banded on branches immediately below the leaves; branches few, thick, 10 to 15 mm. thick within 15 cm. from the apex; leaves crowded at apex of branch, pendent, minutely serrulate, glabrous, grayish green, 115 to 140 cm. in length, 18 to 20 mm. in width; leaf-base enlarged, amplexicaul, the basal 10 cm. entire-margined; lamina linear, narrowed above the clasping base, apex attenuate to a broadly setiform tip.

This interesting species was found only in Monte Hiltun where there is a small grove in the limestone valley. The trees were not in flower or fruit, so that only sterile material was obtained, therefore I am uncertain about the generic position of the species.

The other New World representative of the genus, *Dracæna americana* Donn. Smith, has been found in Northern Petén and British Honduras. It is a smaller tree with entire leaves 20 to 30 cm. in length.

*Echeandia parviflora* Baker. La Libertad, *Aguilar* 305. A perennial; collected in wet grasslands the latter part of June.

*Yucca elephantipes* Regel. *Palmera*. La Libertad, *Lundell* 2531. A cultivated tree; the flowers are eaten as a vegetable.

## SMILACACEÆ

*Smilax mollis* H. & B. *Ixcoke*, *Diente de venado*, *Diente de perro*. La Libertad, *Lundell* 2834, 2858, 3066, 3473. A suffrutescent vine; occasional in marginal forest and hill cap forest.

*Smilax spinosa* Mill. *Diente de perro*, *Bejuquillo de hierro*. La Libertad, *Lundell* 2259, 2270, 2337, 3466, 3536; *Aguilar* 257. A slender somewhat woody vine of marginal forest; occasional.

## DIOSCOREACEÆ

*Dioscorea alata* L. *Macal*. La Libertad. Cultivated.

*Dioscorea bernoulliana* Pr. & Burk. La Libertad, *Aguilar* 470.

*Dioscorea bulbifera* L. *Papa voladora*. La Libertad, *Aguilar* 221, 223. Cultivated herbaceous vine; the roots and bulblets are eaten.

## AMARYLLIDACEÆ

*Agave sisalana* Perrine. *Henequen*. La Libertad, *Lundell* 3528. Cultivated to a limited extent; all the fiber is used locally.

*Bomarea ovata* (Cav.) Mirb. La Libertad, *Aguilar* 215.

*Curculigo scorzonifolia* (Lam.) Baker. La Libertad, *Lundell* 3451, 3630; *Aguilar* 163. A common small, yellow-flowered perennial; very conspicuous in the well-drained grasslands at the beginning of the wet season.

*Hippeastrum puniceum* (Lam.) Urban. *Lirio*. La Libertad, *Lundell* 2413. A handsome bulbous perennial, flowering at the beginning of the rainy season; cultivated for ornament.

*Hymenocallis littoralis* (Jacq.) Salisb. *Lirio zac*. La Libertad, *Lundell* 3622. A bulbous white-flowered perennial; characteristic of swampy grasslands.

*Hypoxis decumbens* L. *Chiche*, *Lundell* 3715. A small herb; common in the well-drained grasslands in June.

*Zephyranthes citrina* Baker. *Hacinto*. La Libertad, *Lundell* 2162, 3350. A small bulbous perennial; cultivated for ornament.

## IRIDACEÆ

*Cipura paludosa* Aubl. La Libertad, *Lundell* 2476, 3646; *Aguilar* 20. A small bulbous perennial; common in the grasslands and on the denuded mounds of Chakantun. It began flowering in May after the first rain.

## MUSACEÆ

*Heliconia latispatha* Benth. *Bijau*. La Libertad, *Aguilar* 319. Coarse plants more than a meter in height; collected by Aguilar in marginal forest.

*Heliconia* sp. *Platanillo*. La Libertad, *Lundell* 3721. Coarse perennial herb; occasional in marginal forest.

*Musa paradisiaca* L. *Platano*. Cultivated.

*Musa sapientum* L. *Guineo*. La Libertad, *Lundell* 3061. Cultivated.

## CANNACEÆ

*Canna edulis* Ker. (?). *Platanillo*. La Libertad, *Aguilar* 391. Large herb; reported by Aguilar as occurring in marginal forest and within the village.

## ZINGIBERACEÆ

*Costus spicatus* (Jacq.) Sw. (?). *Caña agria*. La Libertad, *Aguilar* 289. A tall herb; collected in "montaña de San Juan"; reported to be used in local medicine.

*Costus* sp. *Caña de Cristo*. La Libertad, *Aguilar* 290. A very slender herb; collected in "montaña de San Juan."

*Renealmia* sp. *Caramon*. La Libertad, *Aguilar* 320. A large herb; collected along an arroyo in wet soils. The fruit is reported by Aguilar to be edible and useful to flavor meat.

## MARANTACEÆ

*Calathea lutea* (Aubl.) Mey. *Moxan*. La Libertad, *Lundell* 2419. A tall coarse herb, growing in clumps in an orchard in La Libertad; apparently introduced. The leaves are employed for wrapping various articles of food.

*Maranta arundinacea* L. La Libertad, *Aguilar* 111. Perennial herb; collected by Aguilar in Sabana Popuctilum.

## ORCHIDACEÆ

*Bletia tuberosa* (L.) Ames. La Libertad, *Lundell* 2710. A tuberous terrestrial; quite common in the well-drained grasslands; flowering begins soon after the first rains.

*Brassia maculata* R. Br. La Libertad, *Lundell* 2637, 2831. Common large plants on the hills; the species grows on mossy rocks or as an epiphyte.

*Bulbophyllum aristatum* (Rehb. f.) Hemsl. La Libertad, *Lundell* 2636. An epiphyte; collected on a hill cap in Monte Chicbul.

*Campylocentrum micranthum* (Lindl.) Rolfe. La Libertad, *Lundell* 2127, 2164. An epiphyte; collected on the hills and in the village.

- Catasetum integerrimum* Hook. La Libertad, Aguilar 220.
- Cranichis* (?). La Libertad, Aguilar 100. A terrestrial; found on a hill at Polol.
- Cyrtopodium punctatum* (L.) Lindl. La Libertad, Lundell 2131. A large orchid; found on a mound in Chakantun; probably an epiphyte.
- Epidendrum aciculare* Batem. La Libertad, Lundell 2274, 2711. An epiphyte on trees of the grasslands and village; not common.
- Epidendrum cochleatum* L. La Libertad, Lundell 2577, 2623; Aguilar 334. Epiphyte of the flatland forest and hills; one of the orchids frequently encountered.
- Epidendrum diffusum* Sw. La Libertad, Lundell 2634. An epiphyte on a hill cap in Monte Chicbul.
- Epidendrum isomerum* Schltr. La Libertad, Lundell 2539. A pendent epiphyte of the flatland forest; encountered only once.
- Epidendrum nocturnum* Jacq. La Libertad, Lundell 2598. An occasional epiphyte of the flatland forest.
- Epidendrum radiatum* Lindl. La Libertad, Aguilar 249. An epiphyte; collected in flatland forest; apparently uncommon.
- Epidendrum rigidum* Jacq. La Libertad, Lundell 3526. A small epiphyte on trees in the village.
- Epidendrum stamfordianum* Batem. La Libertad, Aguilar 462.
- Epidendrum stenopetalum* Hook. La Libertad, Lundell 2230, 2323, 2567. An epiphyte; rather common in flatland forest.
- Epidendrum strobiliferum* Rchb. f. La Libertad, Lundell 2128, 2142, 2597. A common epiphyte of all habitats.
- Gongora quinquenervis* Ruiz & Pav. La Libertad, Aguilar 372. Collected in high forest by Aguilar.
- Habenaria odontopetala* Rchb. f. La Libertad, Aguilar 156. A terrestrial orchid; collected at the savanna edge of marginal forest.
- Habenaria setifera* Lindl. La Libertad, Aguilar 208. A terrestrial orchid of well-drained grasslands.
- Jacquinella globosa* Schltr. La Libertad, Lundell 2236, 2256. Small uncommon epiphyte in marginal forest.
- Leochilus* sp. La Libertad, Lundell 2314. Small uncommon epiphyte in marginal forest.
- Maxillaria crassifolia* (Lindl.) Rchb. f. La Libertad, Lundell 2999. An epiphyte; occasional on the hills.
- Maxillaria friedrichsthalii* Rchb. f. La Libertad, Lundell 2367; Aguilar 99. Infrequent epiphyte on trees of the flatlands.
- Maxillaria tenuifolia* Lindl. La Libertad, Lundell 2632, 2638. An epiphyte; collected on a hill cap in Monte Chicbul.
- Maxillaria uncata* Lindl. La Libertad, Lundell 2324. An epiphyte on a nanze tree in the grasslands.
- Notylia trisepala* Lindl. & Paxt. La Libertad, Lundell 2146, 2275. An epiphyte; found only on trees in the village.
- Oncidium ascendens* Lindl. La Libertad, Lundell 2165, 2277, 2332; Aguilar 386. A common epiphyte; collected on trees of the village and marginal forest.
- Oncidium luridum* Lindl. La Libertad, Lundell 3765.
- Oncidium pusillum* (L.) Rchb. f. La Libertad, Lundell 2992. A small epiphyte.
- Oncidium sphacelatum* Lindl. La Libertad, Lundell 2134, 2639; Aguilar 331. A very common large epiphyte; collected on the hills and in flatland forest.
- Pleurothallis comayaguensis* Ames. La Libertad, Lundell 2140, 2235. A very small epiphyte; collected on the mounds in Chakantun and in marginal forest.
- Pleurothallis marginata* Lindl. La Libertad, Lundell 2339; Aguilar 230. A small epiphyte; occasional on trees in the marginal forest.
- Pleurothallis purpusii* Schltr. La Libertad, Lundell 2138, 3893. A small epiphyte; occasional on mounds in Chakantun and on trees in the village.
- Polystachya* sp. La Libertad, Lundell 2144, 2381, 2428. A small epiphyte; on mounds in Chakantun, in marginal forest, and on trees in the village. It is probable that more than one species is represented. Only fruiting specimens were obtainable during the dry season.
- Scaphyglottis livida* (Lindl.) Schltr. La Libertad, Lundell 2231. A small uncommon epiphyte; collected in marginal forest.
- Schomburgkia tibicinis* Batem. (?). *Boxin*. La Libertad, Lundell 3000, 3229. A very large "trumpet" orchid, forming large masses on trees; it is inhabited by vicious ants. Collections were



made on a hill cap near Chakantun in Monte Caoba, and in the marginal forest near Aguada Copo. The specimens may represent an undescribed species.

*Sobralia decora* Batem. (?). La Libertad, *Lundell* 2961, 2962. An epiphyte on the hills; not common. Only fruiting specimens were obtainable which makes the determination doubtful.

*Sobralia* sp. La Libertad, *Lundell* 2625. An uncommon epiphyte; collected with the other species on a hill cap in Monte Chicbul. Only sterile material was obtainable.

*Spiranthes aguacatensis* Rehb. f. Chiche, *Lundell* 3704. A small terrestrial plant with a cluster of fleshy roots; quite common in the well-drained grasslands near the village of Chiche. This is one of the many interesting small plants which make their appearance in the savannas at the beginning of the wet season.

*Stanhopea* sp. La Libertad, *Lundell* 3101. A large epiphyte; encountered once in flatland high forest of Monte Chicbul.

*Stelis ciliaris* Lindl. La Libertad, *Lundell* 2141, 2963; *Aguilar* 230A. A small epiphyte; occasional in all habitats.

*Stelis rubens* Schltr. var. *oxypetala* (Schltr.) Ames. La Libertad, *Aguilar* 291. Small epiphyte; collected in marginal forest.

*Stenorrhynchus orchioides* (Sw.) L. C. Rich. *Azucena del campo*. La Libertad, *Lundell* 2748, 3484, 3625, 3677; *Aguilar* 365. A terrestrial plant with a cluster of fleshy roots; the species is quite common in the well-drained grasslands at the beginning of the wet season.

*Trigonidium egertonianum* Batem. La Libertad, *Lundell* 2278, 2566, 2635. An epiphyte; occasional in all habitats.

*Vanilla fragrans* (Salisb.) Ames. *Vainilla*. La Libertad, *Aguilar* 164. A large fleshy vine; collected in marginal forest. The pods are used for flavoring.

#### PIPERACEÆ

*Peperomia chicbulana* Trel. La Libertad, *Lundell* 3099, type collection. A fleshy epiphytic vine; collected on a half fallen tree in high forest of Monte Chicbul.

*Peperomia lundellii* Trel. La Libertad, *Lundell* 3338. A fleshy trunk epiphyte; collected in marginal forest.

*Peperomia pellucida* (L.) HBK. *Mazamorra*. La Libertad, *Aguilar* 143. A small fleshy terrestrial annual of the grasslands. It is used in local medicine.

*Peperomia petenensis* Trel. La Libertad, *Lundell* 2129, type collection; 2939; *Aguilar* 288. Plant with large fleshy leaves; abundant on mossy rocks of hill caps.

*Peperomia polochicana* Trel. La Libertad, *Lundell* 2938, 3045. A very small common epiphyte; collected on the hills and in the village.

*Peperomia pololensis* Trel. La Libertad, *Lundell* 3040, type collection; 3100, 3102. A small subscandent trunk epiphyte of high forest.

*Piper discolor* Trel. La Libertad, *Lundell* 2565, type collection; 4886. A flatland forest shrub; occasional.

*Piper emancipationis* Trel. La Libertad, *Lundell* 3658, type collection. A very common low shrub in the high forest of Monte Chicbul.

*Piper emancipationis* Trel. var. *longum* Trel. *Pooczuyaax*. La Libertad, *Lundell* 3052, type collection. A shrub; collected in the Santa Cruz limestone valley forest.

*Piper multinervium* Mart. & Gal. La Libertad, *Lundell* 3008. A large shrub or treelet of marginal forest.

*Piper plumbeicolor* Trel. La Libertad, *Lundell* 2554, type collection. A large shrub or treelet of marginal forest.

*Piper rematense* Trel. La Libertad, *Aguilar* 252. A shrub of marginal forest.

*Piper sempervirens* (Trel.) Lundell. La Libertad, *Lundell* 3500. A shrub; occasional in high forest.

*Piper yucatanense* C. DC. La Libertad, *Lundell* 3657. A shrub; occasional in high forest.

*Piper* sp. La Libertad, *Lundell* 2808. A large shrub; collected in the village.

*Piper* sp. La Libertad, *Lundell* 3524. A shrub.

#### MORACEÆ

*Artocarpus communis* Forst. *Castagña*. La Libertad, *Lundell* 3385. A giant tree; planted for shade.

*Brosimum alicastrum* Sw. *Ramon, Ox.* La Libertad, *Lundell* 3256, 3515. A tree; commonly planted in villages.

*Castilla elastica* Cerv. *Hule.* La Libertad, *Lundell* 2156, 3349. A common tree around villages.

*Cecropia* spp. *Ixcoochle, Guarumo.* La Libertad, *Lundell* 3006, 3016. Small trees; common in marginal forest and abandoned milpas.

*Coussapoa oligocephala* Donn. Sm. *Copo zotz.* La Libertad, *Lundell* 3535. Large infrequent tree of the marginal forest.

*Dorstenia contrajerva* L. *Contrayerba.* La Libertad, *Aguilar* 250. A small perennial herb; occasional in forests.

*Ficus cookii* Standl. (?). La Libertad, *Lundell* 2267. A hemi-epiphyte on *Acrocomia mexicana* in marginal forest.

*Ficus involuta* (Liebm.) Miq. *Copo zotz.* La Libertad, *Lundell* 2497, 2973, 3093, 3351, 3547. Large common trees of the flatland forest; most abundant in marginal and aguada bank zones.

*Ficus lundellii* Standl. *Amate.* La Libertad, *Lundell* 2464, 2922, 3249, 3406, type collection; 3655; *Aguilar* 210. A small tree 5 to 8 meters high; most abundant on the hills, but also present in the flatland forest and in the well-drained grasslands.

*Ficus ærstediana* Miq. *Chiche,* *Lundell* 3706. A large tree, growing beside the aguada in the village.

*Ficus radula* Willd. *Chimon.* La Libertad, *Lundell* 2426, 3264. A common tree of aguada and lake banks; collected in the village, and on the swampy bank of Aguada Chimah Pequeño.

*Ficus segoviae* Miq. La Libertad, *Lundell* 3334. A large tree of flatland high forest.

*Ficus tuerckheimii* Standl. La Libertad, *Lundell* 3253, 3276. A large tree of flatland forest.

#### URTICACEÆ

*Laportea mexicana* (Liebm.) Miq. *Laal, Ortiga.* La Libertad, *Lundell* 3104. A small tree of the marginal thickets; planted occasionally in villages because of its reputed value in the treatment of fever.

#### LORANTHACEÆ

*Oryctanthus cordifolius* (Presl) Urban. La Libertad, *Lundell* 3478. A shrub. All the plants of this family are parasites growing on crowns of trees and shrubs. This species was collected around Aguada Chacah.

*Phoradendron franciscanum* Trel. *Mata palo.* La Libertad, *Lundell* 2398, type collection; 3834; *Aguilar* 12. A shrub, growing on nanze and saha trees in the grasslands; quite common.

*Phoradendron gaumeri* Trel. La Libertad, *Lundell* 3395. A shrub; collected on a nanze tree.

*Phoradendron liberdadanum* Trel. La Libertad, *Lundell* 2401, type collection. An uncommon shrub, growing on *Cochlospermum* in marginal forest.

*Phoradendron petenense* Trel. La Libertad, *Lundell* 2400, type collection. An infrequent shrub; found in the campo on a saha tree.

*Phoradendron zacapanum* Trel. La Libertad, *Lundell* 2819. A shrub; collected on a tree in the village.

*Psittacanthus calyculatus* (DC.) Don. *Mata palo.* La Libertad, *Aguilar* 384. A shrub with flaming red flowers.

*Struthanthus cassythoides* Millsp. *Mata palo.* La Libertad, *Lundell* 3527. A slender, somewhat woody vine, completely covering the crown of shrubs and often forming large hanging intertwined masses on trees.

*Struthanthus orbicularis* (HBK.) Blume. *Bejuco seca palo.* La Libertad, *Lundell* 3529; *Aguilar* 256, 358. A large woody vine, forming large hanging masses on trees; quite common. Aguilar reports that the plant is used in the treatment of gonorrhoea.

#### ARISTOLOCHIACEÆ

*Aristolochia odoratissima* L. *Wako, Patito.* La Libertad, *Lundell* 2318. A suffrutescent vine; collected in the village.

#### OLACACEÆ

*Schæpfia schreberi* Gmel. *Limoncillo.* La Libertad, *Lundell* 2326. A large shrub or treelet of the marginal forest.

*Ximenia americana* L. *Saaxnic*, *Tocote de monte*. La Libertad, Lundell 2575, 2975, 3270, 3331; Aguilar 281. A common large gnarled shrub with stout spines; one of the characteristic species of the marginal forest. The fruit is a yellow, plum-like, edible drupe.

## POLYGONACEÆ

*Antigonon leptopus* Hook. & Arn. *San Diego*. La Libertad, Lundell 2809. A large suffrutescent vine; commonly planted for ornament.

*Coccoloba belizensis* Standl. La Libertad, Lundell 3463. A slender tree with very large leathery leaves; found once in marginal forest.

*Coccoloba schiedeana* Lindau. *Cholop*, *Cholob*. La Libertad, Lundell 3212, 3230, 3340, 3570; Aguilar 275, 313. A tree 4 to 10 meters in height; common around *aguadas*, occasional in other habitats. It is probable that several species are represented by the collections.

*Gymnopodium floribundum* Rolfe. La Libertad, Lundell 3516. A giant liana; occasional on hills.

## AMARANTHACEÆ

*Achyranthes indica* (L.) Mill. *Mozotlexc*. La Libertad, Aguilar 401. A weedy herb of inhabited clearings.

*Alternanthera repens* (L.) Kuntze. *Sanguinaria*. La Libertad, Aguilar 376. A prostrate weedy annual, growing in the streets between the cobblestones. Aguilar reports that as a medicinal plant it is used chiefly to improve the blood.

*Amaranthus spinosus* L. *Ixtez*, *Bledo*. La Libertad, Lundell 2172, 3033. A spiny weedy annual of inhabited clearings.

*Celosia cristata* L. *Mano de leon*. La Libertad, Lundell 2412. Commonly planted for ornament.

*Gomphrena globosa* L. *Amor seco*. La Libertad, Aguilar 361. Cultivated for ornament. The plant is locally reputed to have sudorific properties.

*Iresine celosia* L. La Libertad, Lundell 2440; Aguilar 93. Slender perennial of marginal forest and inhabited areas.

## NYCTAGINACEÆ

*Berhaavia coccinea* Mill. *Ericipela*. La Libertad, Aguilar 151. An herb of inhabited clearings; used locally in treatment of erysipelas.

*Bougainvillea glabra* Choisy. *Bogambilla*. La Libertad, Lundell 2369, 2371. A large woody vine; planted for ornament.

*Neea choriophylla* Standl. La Libertad, Lundell 3427. An infrequent shrub; collected in flatland forest.

*Neea psychotrioides* Donn. Sm. La Libertad, Lundell 2418, 2833, 3001, 3405. A low tree; much in evidence on the hills.

*Torrubia petenensis* Lundell. La Libertad, Lundell 3518, type collection. A tree about 8 meters high; collected on a hill cap; apparently rare.

## PORTULACACEÆ

*Talinum paniculatum* (Jacq.) Gaertn. La Libertad, Aguilar 364. An herb of inhabited clearings; used locally for the treatment of inflammation.

## CARYOPHYLLACEÆ

*Dianthus chinensis* L. *Clavel roja*. La Libertad, Lundell 2983. Cultivated for ornament.

*Drymaria cordata* (L.) Willd. La Libertad, Aguilar 193. An annual of inhabited clearings.

## RANUNCULACEÆ

*Clematis dioica* L. *Zepit*, *Barba de viejo*. La Libertad, Aguilar 92, 212, 340. A woody vine of the flatland forest.

## MENISPERMACEÆ

*Cissampelos pareira* L. *Bejuco la preñada*, *Hierba estrella de la preñada*. La Libertad, Lundell 2111, 2257, 3636, 3737; Aguilar 393. A suffrutescent vine of the marginal forest; used locally in the treatment of erysipelas and fever.

*Hyperbæna nectandrifolia* Standl. La Libertad, Aguilar 244. An uncommon low tree of the hills.

#### ANNONACEÆ

*Annona muricata* L. Guanabana. La Libertad, Lundell 2373. A cultivated fruit tree.

*Annona squamosa* L. Chirimoya, Zaramuya. La Libertad, Lundell 2300; Aguilar 122. A cultivated fruit tree. Aguilar reports that the leaves of the plant are placed in the bath water of children to refresh them when they are irritated.

*Malmea depressa* (Baill.) Fries. La Libertad, Lundell 2100, 2339. A slender occasional shrub of the hills.

*Xylopia frutescens* Aubl. Sastante, Majahua, Capulincillo, Capulin de montaña. La Libertad, Lundell 2243, 2341, 2557, 3086; Aguilar 371. A tall slender tree; characteristic of the marginal forest where it occurs in abundance; locally used in the treatment of colic and other ailments.

#### LAURACEÆ

*Cassytha filiformis* L. La Libertad, Lundell 3508. A slender parasitic vine.

*Misanteca campechiana* (Standl.) Lundell. Ektit, Dzol. La Libertad, Lundell 3065, 3359, 3409. A small tree 5 to 8 meters in height; occasional in the marginal and aguada bank zones.

*Misanteca* sp. Zootzni. La Libertad, Lundell 2865, 3435. A low infrequent tree of hill forest and flatland forest.

*Nectandra globosa* (Aubl.) Mez. (?). Sakalante, Zunonte. La Libertad, Lundell 3344, 3628. A tree 5 to 15 meters high; quite common in flatland forest.

*Nectandra membranacea* Griseb. (?). Laurel, Laurel blanco. La Libertad, Lundell 2578, 3348. A tree 5 to 15 meters high; occasional in flatland forest.

*Nectandra sanguinea* Rottb. (?). Laurel, Laurel blanco. La Libertad, Lundell 2113, 2176, 2219, 3716; Aguilar 91, 387. A very common small tree of flatland forest. It is probable that several species are represented by the collections.

*Persea americana* Mill. On, Aguacate. La Libertad, Lundell 2798; Aguilar 397. One of the commonest cultivated fruit trees.

*Phæbe mexicana* Meissn. (?). Aguacatillo. La Libertad, Lundell 2346. A small tree of marginal forest.

#### PAPAVERACEÆ

*Argemone mexicana* L. Cardosanto. La Libertad, Lundell 2155; Aguilar 399. A weedy herb of inhabited clearings; occasional in the grasslands; used in local medicine.

#### CAPPARIDACEÆ

*Capparis stenophylla* Standl. La Libertad, Lundell 3443. A tall shrub; collected in the forest covering the ruins of Polol; apparently uncommon in the region.

*Cleome aculeata* L. La Libertad, Aguilar 116. An annual; collected on an aguada bank.

*Cleome serrata* Jacq. Miramelinda. La Libertad, Aguilar 107. An annual; collected on an aguada bank.

*Gynandropsis speciosa* (HBK.) DC. Alcachofla. La Libertad, Lundell 2414; Aguilar 34, 416. Planted for ornament.

#### CRUCIFERÆ

*Brassica juncea* (L.) Coss. Mostaza, Colinabo. La Libertad, Aguilar 367, 415. Cultivated as a vegetable and for its value in local medicine.

*Lepidium virginicum* L. Mastuerzo. La Libertad, Aguilar 60. An annual of inhabited clearings. Aguilar states that it is used in treating toothache.

#### MORINGACEÆ

*Moringa oleifera* Lam. Paraiso blanco. La Libertad, Lundell 2404. A small tree; apparently planted for ornament.

#### ROSACEÆ

*Couepia dodecandra* (DC.) Hemsl. Uspip, Zuspi. La Libertad, Lundell 3267, 3719, 4881; Aguilar 36. A fruit tree.

*Hirtella americana* L. *Aceituno peludo*. La Libertad, Lundell 2099, 2435, 2859, 2956; Aguilar 329. A common tall shrub or treelet of the hills; fruit edible, although not especially palatable.

*Hirtella racemosa* Lam. *Aceituno Colorado*. La Libertad, Lundell 2217, 3049, 3079; Aguilar 190. A tall very common shrub of flatland forest; fruit edible. The former species is confined almost entirely to the limestone hills, the latter to the deep clay flatlands.

*Rosa indica* L. *Hechisa*. La Libertad, Aguilar 108. Planted for ornament.

## CONNARACEÆ

*Cnestidium rufescens* Planch. *Bejuco Colorado*, *Uayumak*. La Libertad, Lundell 2223, 2345, 2542, 3012, 3026, 3248, 3371, 3551, 4870; Aguilar 14, 299, 310. A large very common liana of flatland forest.

*Rourea glabra* HBK. *Uayumak*. La Libertad, Lundell 3010, 3011, 3051; Aguilar 300. A large common liana of flatland and limestone valley forest.

## LEGUMINOSÆ

*Acacia angustissima* (Mill.) Kuntze. La Libertad, Lundell 3510; Aguilar 149. A gnarled tree; occasional in the grasslands, and on mounds at Chakantun.

*Acacia cookii* Safford (?). *Subin*, *Cornezuelo*. La Libertad, Lundell 2611, 3087. A shrub or slender tree; occasional in flatland forest.

*Acacia costaricensis* Schenck. (?). *Subin Colorado*. La Libertad, Lundell 2379, 2614, 3088, 3660. A shrub or slender tree; common in the flatland forest.

*Acacia farnesiana* (L.) Willd. La Libertad, Aguilar 382. A large shrub of marginal forest. Aguilar reports that the flowers are used to make perfume.

*Acacia spadicigera* Schl. & Cham. (?). *Subin*, *Subin blanco*. La Libertad, Lundell 2240, 2613, 3659. A shrub or slender tree of flatland forest; common in marginal areas.

*Æschynomene fascicularis* Schl. & Cham. La Libertad, Lundell 3413. A slender subshrub of the taller marginal forest; encountered only once.

*Albizia idiopoda* (Blake) Britt. & Rose. La Libertad, Lundell 2876, 3616. A tree 6 to 15 meters high; occasional on the hills and in flatland forest.

*Bauhinia divaricata* L. La Libertad, Lundell 3277. A shrub or small tree; not common in the savanna country.

*Bauhinia glabra* Jacq. La Libertad, Aguilar 430. A large liana of flatland forest; not common.

*Bauhinia unguolata* L. *Pata de vaca*. La Libertad, Lundell 2437, 2560; Aguilar 342. A slender shrub of marginal forest; locally abundant.

*Cesalpinia pulcherrima* (L.) Sw. *Zinkin*, *Cabello de angel*. La Libertad, Lundell 2407. A tree; planted for ornament.

*Cajanus bicolor* DC. *Chicharo*. La Libertad, Lundell 2317, 3386; Aguilar 95. A shrub; cultivated for its edible seed.

*Calliandra* sp. *Tukuy*, *Mota*, *Pato de cerdo*, *Chultejillo*. La Libertad, Lundell 2843, 2870, 2904, 3422; Aguilar 356. A slender shrub in all forest habitats except *aguada* bank; often planted in the villages for ornament.

*Calliandra houstoniana* (Mill.) Standl. La Libertad, Lundell 2977. Large shrub or treelet of marginal forest; occasional.

*Calopogonium brachycarpum* Benth. La Libertad, Aguilar 405. An herbaceous vine of marginal forest.

*Canavalia villosa* Benth. *Belencok*. La Libertad, Aguilar 228. An herbaceous vine of marginal forest.

*Cassia emarginata* L. La Libertad, Lundell 2616. A large subscandent shrub of marginal forest.

*Cassia flexuosa* L. La Libertad, Lundell 1639, 2402, 3512, 3673, 3740. A very common perennial of the well-drained grasslands; it has a woody underground stem.

*Cassia grandis* L. f. *Bocot*. La Libertad, Lundell 2427. A large tree. At Chiche there is a grove of this species beside the *aguada*.

*Cassia hirsuta* L. *Frijolin macho*. La Libertad, Aguilar 421. A subshrub of the grasslands.

*Cassia moschata* HBK. *Bocotillo*, *Cañafistula*. La Libertad, Lundell 3546; Aguilar 336. A large tree up to 30 meters in height; occasional in flatland high forest.

*Cassia occidentalis* L. *Frijolillo*. La Libertad, Lundell 2166; Aguilar 200. A weedy subshrub of inhabited clearings; important in domestic medicine for treating fever and heart trouble. Aguilar states that the seeds are used as a substitute for coffee.

*Cassia oxyphylla* Kunth. *Flor de muerto*. La Libertad, Lundell 2465, 2543; Aguilar 127. A shrub; collected on a mound in Chakantun and at the edge of an *aguada*.

*Cassia stenocarpa* Vog. *Colhat*. La Libertad, Aguilar 314. A shrub; collected on the bank of Aguada El Progreso.

*Cassia tagera* L. La Libertad, Lundell 2303, 3571. A prostrate perennial; common in well-drained grasslands.

*Cassia undulata* Benth. La Libertad, Lundell 2954. A shrub of the marginal forest.

*Centrosema angustifolium* (HBK.) Benth. La Libertad, Lundell 2289, 3486, 3739; Aguilar 201, 202. A subscandent perennial; common in well-drained grasslands.

*Centrosema virginianum* (L.) Benth. La Libertad, Lundell 2222, 2273, 2330, 2364, 2431, 2513. A slender herbaceous vine; common in marginal forest, occasional in other flatland habitats.

*Clitoria guianensis* (Aubl.) Benth. *Yerba de Mayo*. La Libertad, Lundell 2745, 3653. A small perennial of well-drained grasslands. The plant has large blue flowers which appear soon after the first rain in May. It is one of the most colorful of all the species of the savannas.

*Clitoria ternatea* L. *Concha blanca*. La Libertad, Lundell 3731. A large vine; planted for ornament.

*Crotalaria maypurensis* HBK. *Chipilin*. La Libertad, Aguilar 32. A shrub; collected in the village. Aguilar states that the leaves are eaten as a vegetable.

*Crotalaria pterocaula* Desv. La Libertad, Lundell 2377. A slender perennial of the well-drained grasslands; rare during the dry season.

*Crotalaria pumila* Ortega. *Chipilincillo*. La Libertad, Aguilar 184. An annual of marginal forest; employed in domestic medicine chiefly in the treatment of boils.

*Dalbergia glabra* (Mill.) Standl. *Kibix*, *Muc*. La Libertad, Lundell 1656, 2529, 2533, 2882, 2905, 3009; Aguilar 283, 385. A very common large woody vine; prominent in marginal forest.

*Desmodium axillare* (Sw.) DC. (?). *Chiche*, Lundell 3710. A perennial of well-drained grasslands.

*Desmodium barbatum* (L.) Benth. & Erst. La Libertad, Aguilar 84. A perennial of well-drained grasslands.

*Desmodium cubense* Griseb. La Libertad, Lundell 2380, 2468, 3667. A small perennial of well-drained grasslands.

*Desmodium frutescens* (Jacq.) Schindler. La Libertad, Lundell 2311, 3530, 4872. A common perennial of well-drained grasslands.

*Dialium guianense* (Aubl.) Steud. *Uapake*. La Libertad, Lundell 3449. A large tree in flatland high forest at Polol.

*Diphyssa carthagenensis* Jacq. *Zuzoc*, *Guachipilín*. La Libertad, Lundell 2450, 2460, 2974; Aguilar 422. A large shrub or treelet of marginal forest; occasional on mounds and in flatland high forest.

*Enterolobium cyclocarpum* (Jacq.) Griseb. La Libertad, Lundell 3687. A giant tree; occasional in limestone valley forest. Plate 38, fig. 1.

*Eriosema pinetorum* Standl. La Libertad, Lundell 2293, 3669, 3734A. A perennial of well-drained grasslands.

*Eriosema diffusum* (HBK.) Don. *Carrillo*. *Chiche*, Lundell 1640; La Libertad, Lundell 2282, 2378, 2390, 3738. A common perennial of well-drained grasslands.

*Eriosema pulchellum* (HBK.) Don. La Libertad, Lundell 2291, 3697, 3734. A common perennial of well-drained grasslands.

*Erythrina americana* Mill. *Pita del monte*. La Libertad, Lundell 3702. A small tree of marginal forest.

*Erythrina rubrinervia* HBK. *Pito*. La Libertad, Lundell 2446. A small tree, growing along a fence row in the village.

*Galactia belizensis* Standl. La Libertad, Lundell 3346. An herbaceous vine; collected in flatland high forest.

*Gliricidia sepium* (Jacq.) Steud. *Kante*, *Madre de cacao*. La Libertad, Lundell 2179, 2420, 2852, 2885. Occasional small tree of the hills.

*Hæmatoxylum campechianum* L. *Palo tinta*. La Libertad, Lundell 3261. A small gnarled tree; found on swampy *aguada* banks and occasionally in the grasslands; important in domestic medicine.

*Hymenæa courbaril* L. *Pakay*, *Uapinol*. La Libertad, Lundell 3044, 3459; Aguilar 253. A giant tree of *aguada* banks; fruits edible.

*Indigofera lespedezioides* HBK. La Libertad, Lundell 2284, 2307; Aguilar 73. A perennial of well-drained grasslands.

*Indigofera suffruticosa* Mill. *Añil de piedra*. La Libertad, Lundell 2320; Aguilar 211. A shrub, growing in the village; probably cultivated.

*Inga paterno* Harms. *Paterna*. La Libertad, Aguilar 377. A tree; apparently planted for its edible fruits.

*Inga leptoloba* Schlecht. *Bitze*, *Paternilla*. La Libertad, Lundell 2105, 2537, 2555; Aguilar 419. A small tree of flatland forest; very prominent in the marginal zone.

*Inga punctata* Willd. *Bitze*. La Libertad, Lundell 3090. A common tree of flatland forest.

*Lysiloma desmostachys* Benth. La Libertad, Lundell 2455. A small gnarled tree about 5 meters high; collected on a mound in Chakantun.

*Machærium merrillii* Standl. La Libertad, Lundell 2399. A large thorny liana, completely covering the trees of a small "wooded island" in Sabana San Francisco.

*Machærium setulosum* Pittier. La Libertad, Aguilar 528.

*Mimosa albida* Humb. & Bonpl. *Zarsa*. La Libertad, Lundell 2269, 2385, 2436, 2452, 2617; Aguilar 219, 398. A very common shrub of grasslands and marginal forest.

*Mimosa pudica* L. *Sensitiva*. La Libertad, Aguilar 343. An annual of the grasslands. Aguilar states that the plant is placed by "enchanters" under pillows to induce sleep.

*Mimosa somnians* Humb. & Bonpl. *Dormilona*. La Libertad, Lundell 2308, 2388, 3744. A small shrub; occasional in well-drained grasslands.

*Mucuna andreana* Micheli. *Ojo de venado*. La Libertad, Aguilar 485.

*Pachyrrhizus erosus* (L.) Urban. La Libertad, Aguilar 439.

*Parosela vulneraria* (Ertst.) Rydb. *Zulcate*. La Libertad, Aguilar 388. A small shrub; collected in marginal forest. Aguilar states that the plant is used in the treatment of head sores.

*Phaseolus gracilis* Poepp. *Flor de reina*, *Frijolillo*. Chiche, Lundell 1638, 1641; La Libertad, Lundell 2281, 2290, 2312, 2383, 2391, 3664, 3668, 3741. A very common small perennial of well-drained grasslands.

*Phaseolus vulgaris* L. *Frijol*. La Libertad. This is the common cultivated bean which ranks next to corn in importance as a food plant in Central America.

*Piscidia piscipula* (L.) Sarg. *Habin*. La Libertad, Lundell 2817, 3075. A tree 5 to 10 meters in height; occasional in marginal forest, rare elsewhere.

*Pithecolobium guatemalense* (Britt. & Rose) Standl. (?). *Yaxek*, *Tinta blanca*. La Libertad, Lundell 2532, 3021. A tree of marginal forest.

*Pithecolobium leucocalyx* (Britt. & Rose) Standl. La Libertad, Lundell 3339. A very large tree; collected in a *zucche*; infrequent.

*Pithecolobium tortum* Mart. *Yaxek*. La Libertad, Lundell 3656. An infrequent marginal forest tree about 6 meters high.

*Rhynchosia longeracemosa* Mart. & Gal. La Libertad, Lundell 2615; Aguilar 213. An herbaceous vine of marginal forest.

*Rhynchosia pyramidalis* (Lam.) Urban. La Libertad, Lundell 2184, 2228, 4420. An herbaceous vine of marginal forest; quite common. The plant is used in domestic medicine to treat coughs.

*Schizolobium parahybum* (Vell.) Blake. *Copte*. La Libertad, Lundell 3074. A giant tree of limestone valley forest; occasional.

*Swartzia lundellii* Standl. *Buluche*. La Libertad, Lundell 2958, 3613, type collection; Aguilar 293. A tree 6 to 10 meters high; occasional on the hills, rare in the flatlands. Aguilar reports that the fruits are eaten by birds and deer.

*Sweetia panamensis* Benth. La Libertad, Aguilar 311. A medium-sized tree of flatland forest; occasional.

*Tamarindus indica* L. *Tamarindo*. La Libertad, Lundell 2795, 3303. A large tree; planted for its fruit.

*Tephrosia littoralis* (L.) Pers. La Libertad, Lundell 2403, 2456, 2712, 2746, 3611, 3666, 3745. A very common perennial of well-drained grasslands.

*Tipuana lundellii* Standl. La Libertad, Lundell 2895, type collection. A forest giant of limestone valleys; occasional in the savanna country.

*Zornia diphylla* (L.) Pers. La Libertad, Lundell 2394, 3665, 3742; Aguilar 5. A common slender perennial of well-drained grasslands.

#### OXALIDACEÆ

*Oxalis nexi* DC. La Libertad, Lundell 3663; Chiche, Lundell 3714. A small perennial of well-drained grasslands; flowered after the first rain in May and became quite common early in June.

*Oxalis yucatanensis* (Rose) Standl. La Libertad, Lundell 3615. A small perennial, appearing in the well-drained grasslands after the first rains in May.



## ERYTHROXYLACEÆ

*Erythroxylon areolatum* L. *Limoncillo*. La Libertad, *Lundell* 2182, 2250, 3366, 3472, 4869. A common shrub of marginal forest.

## ZYGOPHYLLACEÆ

*Kallstroemia maxima* (L.) Torr. & Gray. La Libertad, *Aguilar* 175. A prostrate annual of inhabited clearings.

## RUTACEÆ

*Citrus aurantifolia* (Christm.) Swingle. *Limon paa*. La Libertad, *Lundell* 3069. A small tree; cultivated for its fruit.

*Citrus sinensis* Osbeck. *Naranja de China*. La Libertad. Cultivated for its fruit. Cut-ants defoliate and kill the trees unless especial caution is taken.

It is probable that several other cultivated species of *Citrus* occur in La Libertad. In the short time spent in the region it was but natural to overlook even some of the commonest things.

*Murraya paniculata* (L.) Jack. *Limonaria*. La Libertad, *Lundell* 3557; *Aguilar* 333. A small tree; commonly planted in villages.

*Zanthoxylum kellermanii* P. Wilson. *Espino*. La Libertad, *Aguilar* 128. A tree; collected by Aguilar on an aguada bank.

*Zanthoxylum procerum* Donn. Sm. *Choonte*, *Kiixche*, *Naranjillo*. La Libertad, *Lundell* 2874, 2972, 3376, 3487. A very common large tree of flatland forest; one of the characteristic species of the high forest.

## MELIACEÆ

*Cedrela mexicana* Roem. *Kuche*. La Libertad, *Lundell* 3060. A large tree, growing in the village.

*Guarea excelsa* HBK. (?). *Lobin*. La Libertad, *Aguilar* 255. A tree; collected in high forest at Polol.

*Melia azedarach* L. *Paraiso*. La Libertad, *Lundell* 2181; *Aguilar* 315. Planted commonly for ornament.

*Swietenia macrophylla* King. *Chacalte*, *Caoba*. La Libertad, *Lundell* 3552. Giant tree of flatland high forest; occasional.

*Trichilia havanensis* Jacq. *Tiricio*. La Libertad, *Aguilar* 477.

*Trichilia hirta* L. *Cedrillo*, *Cedro colorado*. La Libertad, *Lundell* 2261, 2548. A medium-sized tree of marginal forest.

*Trichilia montana* HBK. La Libertad, *Aguilar* 1. A forest tree.

*Trichilia cerstediana* C. DC. *Tiricio*. La Libertad, *Lundell* 3343. A tree of flatland forest.

*Trichilia trifolia* L. La Libertad, *Lundell* 2335, 2600, 3024. A low gnarled tree or large shrub; common in and around sinkholes.

## SIMARUBACEÆ

*Alvaradoa amorphoides* Liebm. *Cola de ardilla*. La Libertad, *Aguilar* 235. Occasional tree of hills.

*Simaruba glauca* DC. *Pasak*, *Chapascuapul*, *Zapatero*, *Flor de pasar*. La Libertad, *Lundell* 2185, 2234; *Aguilar* 363. A medium-sized tree of marginal forest; common. The insipid fruits, which ripen in May, are edible.

## BURSERACEÆ

*Bursera simaruba* (L.) Sarg. *Chacah*, *Chacah colorado*, *Palo mulato*. La Libertad, *Lundell* 2857, 3013, 3358, 3650. A common tree of all well-drained forest habitats. Some of the trees have a whitish to light-gray, rough bark; these are called *chacah blanco*.

*Protium copal* (Schl. & Cham.) Engler. *Pom*, *Copal*. La Libertad, *Lundell* 2262, 2481, 2871, 2957. A small tree; common on the hills, occasional in flatland forest.

## MALPIGHIACEÆ

*Banisteria beecheiana* (Juss.) C. B. Rob. La Libertad, *Aguilar* 429. A liana of flatland forest; occasional.

*Banisteria laurifolia* L. *Pomposa*. La Libertad, *Lundell* 3025, 3035, 3257, 3430, 3544, 4880. Common large liana of marginal forest and banks of sinkholes.

*Bunchosia lanceolata* Turcz. La Libertad, Lundell 3499, 3761. Occasional heliophobous shrub of high forest.

*Bunchosia swartziana* Griseb. var. *yucatanensis* Ndzu. Zipiche, Genit, Hoja del viento. La Libertad, Lundell 2474, 2920, 3488, 3567, 3691; Aguilar 245. Very common slender shrub or treelet of the hills.

*Byrsonima crassifolia* (L.) HBK. Chi, Nanze. La Libertad, Lundell 1648, 2348, 2573, 3007. A common low gnarled tree of the grasslands and marginal forest. The fruit is an edible yellow drupe, highly prized by local residents.

*Hiraea obovata* (HBK.) Ndzu. Igchej, Bejuco mariposa blanca. La Libertad, Lundell 3363, 3370; Aguilar 294, 328. Common large liana of marginal forest; used for cordage.

*Malpighia glabra* L. La Libertad, Aguilar 285. A small tree of the hills; occasional.

*Malpighia puniceifolia* L. Tocab. La Libertad, Lundell 3356, 3568, 3612, 3732; Aguilar 261. A large shrub or treelet of hill and marginal forest.

*Tetrapteris schiedeana* Cham. & Schl. Bejuco treach. La Libertad, Aguilar 233, 425. Occasional liana of hill and marginal forest; used for cordage.

#### VOCHYSIACEÆ

*Vochysia hondurensis* Sprague. Sayuk, Palo bayo. La Libertad, Lundell 3039, 3448. A large tree in flatland high forest at Polol; occasional.

#### POLYGALACEÆ

*Bredemeyera lucida* (Benth.) Benn. La Libertad, Lundell 2847. Rare liana of marginal forest.

*Polygala bryzoides* St. Hil. La Libertad, Lundell 3701; Aguilar 53. Small herb of well-drained grasslands; occasional.

*Polygala consobrina* Blake. La Libertad, Lundell 3644, 3681. Slender herb of well-drained grasslands; quite common late in May after the first rains.

*Polygala longicaulis* HBK. La Libertad, Lundell 2309, 2485; Aguilar 74. Slender, relatively tall herb, becoming common in the well-drained grasslands late in May.

*Polygala wrightii* Chod. (?). La Libertad, Lundell 3661. Rare small herb of well-drained grasslands; flowered late in May.

*Securidaca diversifolia* (L.) Blake. Bejuco anicillo. La Libertad, Aguilar 374. A large liana of flatland forest; occasional.

*Securidaca sylvestris* Schlecht. La Libertad, Lundell 2744, 2893, 2894. A liana of hills and marginal forest; occasional.

#### DICHAPETALACEÆ

*Dichapetalum donnell-smithii* Engler. La Libertad, Aguilar 243. Occasional large woody vine of hills; used for cordage.

#### EUPHORBIACEÆ

*Acalypha arvensis* Poepp. & Endl. Corrimiento. La Libertad, Aguilar 105. An annual of inhabited clearings; used locally in the treatment of toothache.

*Acalypha lancetillæ* Standl. Kadillo. La Libertad, Lundell 3554. A tall slender shrub or treelet of marginal forest; not common.

*Acalypha setosa* A. Rich. La Libertad, Aguilar 157. Common weedy annual of inhabited clearings.

*Acalypha unibracteata* Muell. Arg. Tornillo. La Libertad, Lundell 3418. A large shrub; collected in an abandoned milpa; common.

*Acalypha villosa* Jacq. La Libertad, Lundell 3429, 3600. Occasional shrub of limestone valley forest and abandoned milpas.

*Acalypha wilkesiana* Muell. Arg. Paslor. La Libertad, Lundell 2796. A shrub; commonly planted in La Libertad.

*Alchornea latifolia* Sw. La Libertad, Lundell 2574, 2829, 3083. A medium-sized tree of flatland forest.

*Bernardia interrupta* (Schlecht.) Muell. Arg. La Libertad, Lundell 3250, 3355. Occasional treelet of marginal forest.

*Caperonia palustris* (L.) St. Hil. La Libertad, Aguilar 132. An herb; collected on the wet bank of Aguada El Progreso.

- Codiaeum variegatum* (L.) Blume. La Libertad, Lundell 2368. Cultivated ornamental shrub.
- Croton glandulosus* L. La Libertad, Aguilar 33. An annual of the grasslands.
- Croton lobatus* L. La Libertad, Aguilar 68. An annual of the grasslands.
- Croton repens* Schlecht. La Libertad, Lundell 2313, 2749, 3514, 3624, 3683, 4875. Very common low perennial of grasslands.
- Croton* sp. *Caret*. La Libertad, Aguilar 463.
- Dalechampia panamensis* Pax & Hoffm. La Libertad, Lundell 3438. A slender vine; collected in an abandoned milpa.
- Dalechampia tiliifolia* Lam. La Libertad, Lundell 2570. A slender vine of marginal forest; not common during dry season.
- Euphorbia brasiliensis* Lam. La Libertad, Lundell 2375, 2491, 3703, 4433. Common small herb of the well-drained grasslands.
- Euphorbia densiflora* Klotzsch. La Libertad, Lundell 2132, 2461. Common, small, prostrate, reddish herb of mounds and grasslands.
- Euphorbia heterophylla* L. *Ixbubt*. La Libertad, Aguilar 350. An erect herb of the grasslands; used in domestic medicine.
- Euphorbia hirta* L. La Libertad, Lundell 2492; Aguilar 176. An annual of grasslands and inhabited clearings.
- Euphorbia hyssopifolia* L. La Libertad, Lundell 2145, 3503. A small annual of mounds and grasslands; collected in Sabana San Francisco.
- Euphorbia pulcherrima* Willd. *Hoja de pascua*. La Libertad, Lundell 2316; Aguilar 389. Cultivated ornamental shrub.
- Jatropha curcas* L. *Piñon*. La Libertad, Lundell 3695. A large shrub; collected in a fence row.
- Manihot esculenta* Crantz. *Yuca*. La Libertad, Lundell 3763. This important food plant is cultivated to a limited extent.
- Pera barbellata* Standl. La Libertad, Lundell 3067. A medium-sized tree; collected on an aguada bank.
- Phyllanthus carolinensis* Walt. La Libertad, Aguilar 61, 204. Small herb of grasslands and inhabited clearings.
- Phyllanthus nobilis* (L. f.) Muell. Arg. La Libertad, Lundell 3432. A common large shrub or treelet.
- Sebastiania longicuspis* Standl. *Chechem blanco*. La Libertad, Lundell 3520. A tree 6 to 15 meters high; locally common on hill slopes.
- Tragia yucatanensis* Millsp. La Libertad, Lundell 3481. A perennial, collected on a denuded limestone hill.
- Tragia* sp. *Pica pica*. La Libertad, Lundell 2487; Aguilar 274. Slender vine, collected in the grasslands and on a denuded hill. Aguilar states that it is used in the treatment of fever.

## ANACARDIACEÆ

- Anacardium occidentale* L. *Marañon*. La Libertad, Lundell 2409, 2801. A small tree, commonly planted for its fruits.
- Astronium fraxinifolium* Schott. *Kulinzis, Hobillo*. La Libertad, Lundell 2881. A tree 15 meters high, collected on a hill top; rare.
- Astronium graveolens* Jacq. *Kulinzis, Hobillo*. La Libertad, Lundell 3095; Aguilar 327. A large tree of flatland high forest; common.
- Mangifera indica* L. *Mango*. La Libertad, Lundell 2804. Probably the commonest fruit tree in La Libertad. The species thrives on the deep clay soils and reaches a greater size than I have observed in any other locality in the Maya country.
- Metopium brownei* (Jacq.) Urban. *Chechem negra*. La Libertad, Lundell 2459, 3063, 3534; Aguilar 335. Probably the commonest tree in the savanna country; it is fire-resistant, hence very prominent in marginal forest and on certain hills.
- Mosquitoxylum jamaicense* Krug & Urban. *Kunte, Pasak macho*. La Libertad, Lundell 3543; Aguilar 318. A large tree of flatland high forest; occasional.
- Spondias mombin* L. *Kinim, Jobo*. La Libertad, Lundell 2352, 3002. A tree 6 to 15 meters in height; characteristic in sections of marginal forest, occasional elsewhere.
- Spondias purpurea* L. *Jobo*. La Libertad, Lundell 2797, 3283. Small cultivated trees, the better of which bear plum-like fruits of excellent quality.

## HIPPOCRATEACEÆ

- Hippocratea* sp. *Bek, Roble*. La Libertad, Lundell 2884. Infrequent hill tree, probably referable to the following species.

*Hippocratea subintegra* Blake. *Zipiche*. La Libertad, *Lundell* 2966, 3062, 3209. A small thick-foliaged tree; occasional on the hills and through the grasslands.

*Hippocratea yucatanensis* Standl. *Forhpac*. La Libertad, *Lundell* 2606, 3330; *Aguilar* 379. Large liana of *aguada* banks and marginal forest; occasional.

## CELASTRACEÆ

*Wimmeria concolor* Schl. & Cham. La Libertad, *Lundell* 2640. A medium-sized tree; collected on a hill in Monte Chicbul; apparently rare in the area.

## SAPINDACEÆ

*Allophylus cominia* (L.) Sw. La Libertad, *Lundell* 2246, 2255; *Aguilar* 296. Small slender tree of marginal forest.

*Allophylus kinlochii* Standl. (?). *Ikbach*, *Chile chachalaca*. Uncommon small tree of marginal forest.

*Cupania belizensis* Standl. La Libertad, *Lundell* 2443; *Aguilar* 218. Medium-sized tree of marginal forest; quite common.

*Cupania glabra* Sw. La Libertad, *Lundell* 2347. Small infrequent tree of marginal forest.

*Matayba oppositifolia* (A. Rich.) Britton. *Zacuayum*. La Libertad, *Lundell* 2514, 2848, 3077; *Aguilar* 325, 370. The dominant tree of flatland high forest; common also in *aguada* bank and marginal forest.

*Paullinia pinnata* L. La Libertad, *Lundell* 3379, 3531; *Aguilar* 248, 287. A woody vine of flatland forest.

*Serjania atrolineata* Sauv. & Wright. *Ixlotoak*. La Libertad, *Lundell* 2115, 2334, 2365, 2366, 2515, 3550. Common liana of flatland forest.

*Serjania goniocarpa* Radlk. La Libertad, *Aguilar* 239. A liana of marginal forest.

*Serjania mexicana* (L.) Willd. *Bolomyok*, *Chacak*, *Barbasco*. La Libertad, *Lundell* 2993, 3014, 3043, 3281. Common liana of marginal forest.

*Talisia olivæformis* (HBK.) Radlk. *Kenep*, *Guayo*. La Libertad, *Lundell* 2985; *Aguilar* 373. A large tree; commonly planted for its fruits, which ripen in May and June.

## BALSAMINACEÆ

*Impatiens balsamina* L. *Chinas*. La Libertad, *Lundell* 2410. Cultivated ornamental herb.

## RHAMNACEÆ

*Colubrina heteroneura* (Griseb.) Standl. *Espina de clavo*. La Libertad, *Lundell* 2218; *Aguilar* 89. Infrequent small thorny tree of marginal forest.

*Colubrina reclinata* (L'Hér.) Brongn. La Libertad, *Lundell* 3419, 3760. Occasional trees, 10 to 15 meters high, in old abandoned *milpas*; collections were made in Monte Chimah and at Polol.

*Gouania polygama* (Jacq.) Urban. *Onak*, *Onhak*. La Libertad, *Lundell* 2358, 3549; *Aguilar* 125, 345. A large liana of flatland forest. An infusion of the crushed bark in water is used as a disinfectant and for treatment of bad gums.

*Sageretia elegans* (HBK.) Brongn. *Canak*. La Libertad, *Lundell* 3360; *Aguilar* 264. Occasional large scandent shrub of marginal forest.

## VITACEÆ

*Ampelocissus erdwendbergii* Planch. *Bejuco de uva*. La Libertad, *Lundell* 3425; *Aguilar* 323. A slender woody vine; collected in an abandoned *milpa*; apparently rare. Heretofore this species has been confused with *A. acapulcensis* (HBK.) Planch., from which it is clearly distinct.

*Cissus rhombifolia* Vahl. La Libertad, *Aguilar* 181. An infrequent woody vine of marginal forest.

*Cissus salutaris* HBK. La Libertad, *Lundell* 3453. Infrequent suffrutescent vine of marginal forest.

*Cissus sicyoides* L. La Libertad, *Lundell* 2124. Occasional woody vine of marginal forest.

*Vitis tilixifolia* Humb. & Bonpl. *Uva*. La Libertad, *Lundell* 3461. Common large liana of marginal forest; fruit small and sour.

## TILIACEÆ

*Corchorus orinocensis* HBK. *Malva rustica*. La Libertad, *Aguilar* 196. An annual of inhabited clearings; employed locally in the treatment of fever.

*Luehea speciosa* Willd. *Kaaskat*. La Libertad, *Lundell* 3542. A tree 6 meters high; occasional in flatland forest.

*Triumfetta semitriloba* Jacq. *Mozote de caballo*. La Libertad, *Aguilar* 188. A weedy shrub of inhabited clearings; said to be used to cure "llagas."

## MALVACEÆ

*Abutilon hirtum* (Lam.) Sweet. La Libertad, *Lundell* 3439. A coarse herb of inhabited clearings.

*Anoda cristata* (L.) Schlecht. La Libertad, *Aguilar* 31. A weedy annual of inhabited clearings.

*Hibiscus abelmoschus* L. *Elvira*. La Libertad, *Aguilar* 216. An herb; collected in a *milpa*. Aguilar states that its seeds are used for treating colic and bites of poisonous snakes.

*Hibiscus diversifolius* Jacq. *Sipipa*, *Corcho*. La Libertad, *Aguilar* 486. In swampy places.

*Hibiscus esculentus* L. La Libertad, *Lundell* 2953. Cultivated as a vegetable.

*Hibiscus mutabilis* L. *Amistad*. La Libertad, *Aguilar* 142. A shrub; planted for ornament.

*Hibiscus rosa-sinensis* L. *Clavel*. La Libertad, *Lundell* 2159, 2315. A shrub; planted for ornament.

*Hibiscus schizopetalus* (Mart.) Hook. *Tulipan*. La Libertad, *Lundell* 2161. A shrub; planted for ornament.

*Hibiscus sororius* L. f. *San Antonio*. La Libertad, *Aguilar* 273. A shrub; collected on a hill.

*Malachra fasciata* Jacq. *Malva rustica*. La Libertad, *Aguilar* 412. A weedy herb of clearings; used in the treatment of fever.

*Malachra radiata* L. *Borraja rustica*. La Libertad, *Aguilar* 167. An herb of the grasslands.

*Malvastrum coromandelianum* (L.) Garcke. La Libertad, *Aguilar* 83. An herb of the grasslands; used to treat "llagas."

*Malvaviscus brevibracteatus* E. G. Baker. *Tulipan*. La Libertad, *Lundell* 2265. Occasional shrub of marginal forest.

*Malvaviscus grandiflorus* HBK. *Tulipancillo*. La Libertad, *Aguilar* 87. Occasional shrub of marginal forest.

*Pavonia rosea* Schlecht. *Mozote*, *Kadillo*. La Libertad, *Lundell* 2820; *Aguilar* 158. Weedy perennial of inhabited clearings.

*Sida acuta* Burm. La Libertad, *Lundell* 2268. A perennial in marginal forest.

*Sida glutinosa* Commers. *Chichibe macho*. La Libertad, *Aguilar* 381. An herb; common along margins of well-drained grasslands.

*Sida lindheimeri* Engelm. & Gray. La Libertad, *Lundell* 2750. Perennial of well-drained grasslands.

*Sida linifolia* Juss. La Libertad, *Aguilar* 380. An herb; collected around margins of the well-drained grasslands.

*Sida paniculata* L. La Libertad, *Aguilar* 369. An herb; collected in marginal forest.

*Sida rhombifolia* L. *Chichibe*. La Libertad, *Aguilar* 169. An herb of the grasslands and clearings; used in the treatment of fevers.

## BOMBACACEÆ

*Bombax ellipticum* HBK. *Chulte*, *Chulte colorado*, *Ceiba*, *Amapola*. La Libertad, *Lundell* 2872; *Aguilar* 282, 366. A common large tree on hills; often planted in villages.

*Ceiba æsculifolia* (HBK.) Britt. & Baker. *Tinanche*, *Kinin*. La Libertad, *Lundell* 3569. Occasional large tree of hills.

*Hampea trilobata* Standl. *Belhi*. La Libertad, *Aguilar* 324. Small tree; collected by Aguilar in marginal forest; not common in the region.

*Pachira aquatica* Aubl. *Zapotebobo*. La Libertad, *Lundell* 3260. A small tree, growing on the swampy banks of Aguada Chimah Pequeño.

## STERCULIACEÆ

*Byttneria aculeata* Jacq. *Zarsahueca*. La Libertad, *Aguilar* 428. Scandent woody shrub of hills and abandoned *milpas*. Aguilar states that it is used to improve the blood and treat boils.

*Guazuma ulmifolia* Lam. *Pixoy*. La Libertad, *Lundell* 3231. A medium-sized tree; common in pastures and around the village.

*Helicteres guazumæfolia* HBK. La Libertad, *Lundell* 2595, 3259, 3464. A large shrub; common around *aguadas*, occasional in marginal forest.

*Melochia hirsuta* Cav. *Malva*. La Libertad, Lundell 2301, 2389, 2612, 3582; Aguilar 172. Common perennial of grasslands and aguada banks.

*Sterculia apetala* (Jacq.) Karst. *Bellota*. La Libertad, Lundell 3254. A giant tree, growing in the village.

*Theobroma cacao* L. *Cacao*. La Libertad, Lundell 2799. Cultivated extensively in the orchards of La Libertad; one of the important food plants of the area.

*Waltheria americana* L. La Libertad, Aguilar 206. A perennial of the well-drained grasslands.

## DILLENIACEÆ

*Curatella americana* L. *Saha*. La Libertad, Lundell 1655, 2266, 2573A; Aguilar 403. Very common, low, gnarled fire-resistant tree of grasslands and marginal forest.

*Davilla kunthii* St. Hil. *Sajab*. La Libertad, Lundell 2183, 2253, 2571; Aguilar 225, 339. Common large liana, characterizing the vanguard belt of the marginal forest. Its rough leaves are used for sandpaper.

*Dolioscarpus dentatus* (Aubl.) Standl. La Libertad, Lundell 2525, 3085. Large woody vine of aguada banks.

*Tetracera volubilis* L. *Bejuco de cachicon*. La Libertad, Lundell 2260; Aguilar 226. Occasional liana of marginal forest.

*Tetracera mollis* Standl. *Bejuco saha*. La Libertad, Lundell 3412. Occasional liana of marginal forest.

## OCHNACEÆ

*Ouratea peckii* Riley. La Libertad, Lundell 2101, 2877, 3258, 3410. Occasional treelet of hill and flatland forest.

## TERNSTRÆMIACEÆ

*Ternstræmia tepezapote* Schl. & Cham. *Panool*, *Chique*, *Roble*, *Chiche*, Lundell 1653; La Libertad, Lundell 2578A, 3036, 3046, 3541, 4883; Aguilar 30. A tree 6 to 10 meters high; occasional through the grasslands and in marginal forest.

## HYPERICACEÆ

*Vismia ferruginea* HBK. *Kuxupche*, *Achiotillo*. La Libertad, Lundell 3064, 3094, 3247, 3327, 3404; Aguilar 126. Very common shrub or treelet of marginal forest; one of the characteristic species of the thorn-scrub belt.

## CLUSIACEÆ

*Clusia flava* Jacq. *Hoja de tortilla*. La Libertad, Lundell 2463, 2853. The characteristic tree of hill caps and limestone mounds.

*Clusia* sp. *Sello*. La Libertad, Aguilar 241. Occasional small tree of hill caps.

*Mammea americana* L. *Mamey*. La Libertad, Lundell 3269. A medium-sized tree; planted for its fruit.

*Rheedia edulis* (Seem.) Triana & Planch. *Palo bayo*. La Libertad, Lundell 3398. Rare tree of flatland forest.

## TURNERACEÆ

*Piriqueta cistoides* (L.) Mey. La Libertad, Lundell 3364, 3642, 3712, 4871; Aguilar 110. Common slender herb of the well-drained grasslands.

*Turnera ulmifolia* L. *Maba cimarron*. La Libertad, Lundell 2451, 3511, 3711; Aguilar 23. Occasional perennial of the well-drained grasslands; used in domestic medicine.

## BIXACEÆ

*Bixa orellana* L. *Pochote*, *Achiote*. La Libertad, Lundell 2441, 3255, 4434. A small cultivated tree.

## COCHLOSPERMACEÆ

*Cochlospermum vitifolium* (Willd.) Spreng. *Pochote*. La Libertad, Lundell 2122, 2434. A small slender tree of marginal forest and fence rows.

## VIOLACEÆ

*Hybanthus angustifolius* (HBK.) Standl. La Libertad, Lundell 3662, 3713. A small grassland perennial.

*Hybanthus longipes* (Dowell) Standl. *Hierba de pesar*. La Libertad, Aguilar 56. A small perennial; generally found around houses in villages; used in domestic medicine.

## FLACOURTIACEÆ

*Casearia aculeata* Jacq. *Pullun*. La Libertad, Lundell 2225, 2254, 2327, 3361, 3368, 3455, 3634, 3638, 4305; Aguilar 29, 180, 303. A large shrub or treelet; very common in marginal and aguada bank forest, occasional in other habitats.

*Casearia javitensis* HBK. *Taixcaax*, *Utaaxcaax*, *Mierda de gallina*. La Libertad, Lundell 3015, 3081, 3456; Aguilar 278. A large tree of flatland high forest and aguada bank forest; one of the characteristic species.

*Casearia nitida* (L.) Jacq. *Bakelak de aguada*. La Libertad, Lundell 3089, 3627, 3723; Aguilar 229. A small tree of flatland forest; encountered oftenest on aguada banks.

*Casearia sylvestris* Sw. La Libertad, Lundell 2610. A small tree; collected on an aguada bank.

*Lætia thamnia* L. *Bakelak*. La Libertad, Lundell 2879, 3353, 3532; Aguilar 284. Common small tree of hill and flatland forest.

*Prockia crucis* L. La Libertad, Lundell 3722. A small forest tree.

*Xylosma anisophylla* Standl. La Libertad, Lundell 2469. A shrub or treelet; collected on the largest mound in Chakantun.

*Xylosma hemsleyana* Standl. (?). La Libertad, Lundell 2143, 2247. A thorny shrub or treelet; in marginal forest and on mounds in Chakantun; occasional.

*Zuelania guidonia* (Sw.) Britt. & Millsp. *Tamay*. La Libertad, Lundell 2338, 3091, 3336, 3545. Common small tree of marginal forest.

## CARICACEÆ

*Carica papaya* L. *Papayo*. La Libertad. Commonly planted for its fruits.

## PASSIFLORACEÆ

*Passiflora biflora* Lam. La Libertad, Lundell 2271, 2272, 3400. Common slender suffrutescent vine of marginal forest.

*Passiflora coriacea* Juss. La Libertad, Lundell 2349, 2439. Slender suffrutescent vine of marginal forest.

*Passiflora fætida gossipiifolia* (Desv.) Mast. *Conbulvulo*. La Libertad, Aguilar 357. An herbaceous vine of marginal forest.

*Passiflora fætida hastata* (Bert.) Mast. *Tujo*, *Pasion*. La Libertad, Lundell 3207, 3357, 3498; Aguilar 2. Common herbaceous vine of marginal forest.

*Passiflora fætida lanuginosa* Killip. La Libertad, Lundell 2227.

## BEGONIACEÆ

*Begonia martiana* Link & Otto. (?). La Libertad, Lundell 2982. Cultivated ornamental herb.

*Begonia nicaraguensis* Standl. *Begonia*. La Libertad, Aguilar 418. Cultivated ornamental herb.

## CACTACEÆ

*Cereus grandiflorus* (L.) Mill. *Tuna cimarrona*. La Libertad, Lundell 3513; Aguilar 262 (?). Common root-climbing epiphyte, forming large masses on trees.

*Cereus hexagonus* (L.) Mill. (?). La Libertad, Lundell 3572. Erect plants 1 to 2 meters in height with large white flowers. The species is planted extensively in La Libertad in fence rows where it forms an impenetrable barrier.

## LYTHRACEÆ

*Cuphea carthagenensis* (Jacq.) Macbride. *Chichibe*. La Libertad, Lundell 2520, 2584, 3477, 3736; Aguilar 37, 104. A common perennial around aguadas.

*Lagerstræmia indica* L. *Jupiter*. La Libertad, Lundell 2405. Cultivated ornamental shrub.

*Lawsonia inermis* L. *Ricidron*. La Libertad, Aguilar 76. A large shrub or treelet, commonly grown for ornament.



## PUNICACEÆ

*Punica granatum* L. *Granado*. La Libertad, *Lundell* 3401; *Aguilar* 352. A cultivated shrub; used in the treatment of dysentery and probably for other purposes.

## COMBRETACEÆ

*Bucida buceras* L. (?). La Libertad, *Aguilar* 349. A large forest tree; generally found in wet areas.

*Combretum farinosum* HBK. *Bejuco cepillo*. La Libertad, *Lundell* 2433; *Aguilar* 341, 420. A large woody scrambler of marginal forest.

*Terminalia catappa* L. *Almendro*. La Libertad, *Lundell* 3268. Planted as a shade tree.

*Terminalia excelsa* Liebm. *Kanxan, Pucte*. La Libertad, *Lundell* 2512, 2916. A giant tree of flatland high forest and limestone valley forest.

## MYRTACEÆ

*Calyptanthus chytraculia* (L.) Sw. *Jolteillo*. La Libertad, *Lundell* 3378. Common shrub or small tree of flatland forest.

*Eugenia capuli* (Schl. & Cham.) Berg. *Chilonche, Chilonche macho, Escobillo*. La Libertad, *Lundell* 2117, 2329, 2336, 2507, 2541, 2581, 2602; *Aguilar* 96, 236. Very common large shrub; especially abundant in marginal and *aguada* bank zones of flatland forest.

*Eugenia jambos* L. *Manzana rosa, Pomarroza*. La Libertad, *Lundell* 2821; *Aguilar* 101. A large tree; planted for its fruits.

*Eugenia vincentina* Krug & Urban. *Jolteillo*. La Libertad, *Lundell* 3631, 3746. A large shrub or treelet; quite common in marginal forest.

*Eugenia xalapensis* (HBK.) DC. La Libertad, *Lundell* 2504. A large shrub or treelet; common on *aguada* banks.

*Myrcia ærstediana* Berg. La Libertad, *Aguilar* 13, 159. A small tree; collected in flatland forest.

*Pimenta officinalis* Lindl. *Pimento*. La Libertad, *Lundell* 3402, 4278. A medium-sized tree; occasionally planted. The species is native in the forest covering the southern half of the Yucatan Peninsula.

*Psidium guajava* L. *Guayabo*. La Libertad, *Lundell* 2596. A shrub or small tree; planted for its fruit.

*Psidium molle* Bertol. *Pichippul, Guayabo*. La Libertad, *Lundell* 2280, 3367. A low shrub; common in the well-drained grasslands immediately surrounding the village of La Libertad.

## MELASTOMATACEÆ

*Clidemia dependens* Don. La Libertad, *Lundell* 3038. Common marginal shrub at Polol.

*Clidemia rubra* (Aubl.) Mart. *Uva*. La Libertad, *Aguilar* 269. A slender shrub of the grasslands. Its small purple fruits are edible and sometimes used for making wine.

*Clidemia serrulata* (Schlecht.) Triana. (?). *Sabana Zotz, Lundell* 1652. A shrub of marginal forest.

*Conostegia xalapensis* (Bonpl.) Don. *Toltejillo, Pasita, Chiche, Lundell* 1654, 1658; La Libertad, *Lundell* 2186, 2245, 2558, 3208; *Aguilar* 424. Very common marginal shrub; the dominant and characteristic plant in many sections of the vanguard thorn-scrub belt. Its small purple fruits are edible.

*Miconia argentea* (Sw.) DC. *Jolte, Tolve, Chiche, Lundell* 1661; La Libertad, *Lundell* 2430, 2536, 3084, 3347; *Aguilar* 348, 368. Very common small tree in marginal and *aguada* bank zones of the flatland forest.

*Miconia hondurensis* Donn. Sm. *Cipit*. La Libertad, *Aguilar* 295. A shrub of marginal forest.

*Miconia ibaguensis* (Humb. & Bonpl.) Triana. La Libertad, *Lundell* 3037, 3454. A marginal shrub; quite abundant at Polol.

*Miconia impetolaris* (Sw.) D. Don. *Chiche, Lundell* 1660. An infrequent small tree of marginal forest.

*Mouriria parvifolia* Benth. *Chicharillo, Cuerno de venado, Cachovenado*. La Libertad, *Lundell* 2576, 2976, 3078, 3471; *Aguilar* 272. A tall shrub; very common in flatland forest.

*Pterolepis trichotoma* (Rottb.) Cogn. La Libertad, *Aguilar* 238. A common wet-season annual; collected around the edges of the well-drained grasslands.

## ONAGRACEÆ

*Jussiaea suffruticosa* L. La Libertad, *Lundell* 2586; *Aguilar* 133. An annual; collected in aguada basins.

## UMBELLIFERÆ

*Eryngium foetidum* L. *Silantro cimarron*. La Libertad, *Aguilar* 131. Aguilar reports that the plant grows in the gardens of La Libertad; used for flavoring food and for various medicinal purposes.

## ARALIACEÆ

*Didymopanax morototoni* (Aubl.) Dcne. & Planch. La Libertad, *Lundell* 3068. A large tree; common in marginal forest, occasional in flatland high forest.

*Gilbertia concinna* Standl. *Xup*. La Libertad, *Lundell* 2880. Medium-sized tree; occasional on the limestone hills.

*Oreopanax guatemalense* (Lem.) Dcne. & Planch. *Pomoche*. La Libertad, *Lundell* 2965, 3465. Occasional low tree of hill and marginal forest; one of the characteristic species of hill caps.

## THEOPHRASTACEÆ

*Jacquinia aurantiaca* Ait. *Chacsik*. La Libertad, *Lundell* 3251, 3411, 3519, 3565, 3633; *Aguilar* 332. A forest shrub; common in *rendzina* soil areas. The stiff red corollas are strung and used as necklaces or for other ornamental purposes. Aguilar states that the seeds are employed for killing intestinal parasites.

## MYRSINACEÆ

*Ardisia compressa* HBK. (?). La Libertad, *Lundell* 2264. Infrequent shrub of marginal forest.

*Ardisia paschalis* Donn. Sm. *X'ilil*. La Libertad, *Aguilar* 55. A shrub; collected in limestone valley forest.

*Parathesis obovata* Standl. *Ixpanol*, *Ixpanpanjul*. La Libertad, *Lundell* 2480, 3057, 3606; *Aguilar* 354. A shrub; collected in marginal forest and on limestone mounds in Chakantun.

## EBENACEÆ

*Diospyros yucatanensis* Lundell. La Libertad, *Lundell* 3560. A large shrub; occasional in marginal forest.

*Diospyros* sp. *Chalhac*. La Libertad, *Aguilar* 286, 321.

## SYMPLOCACEÆ

*Symplocos martinicensis* Jacq. La Libertad, *Lundell* 3571. Rare small tree; encountered once in marginal forest.

## SAPOTACEÆ

*Achras zapota* L. *Ya*, *Zapote*, *Chicozapote*. La Libertad, *Lundell* 2805. Planted for its fruits; occasional on the limestone hills.

*Calocarpum mammosum* (L.) Pierre. *Mamey*. La Libertad, *Lundell* 2826. A giant tree; cultivated for its fruits.

*Chrysophyllum cainito* L. *Caimito*. La Libertad, *Lundell* 2496; *Aguilar* 154. A medium-sized tree; planted commonly for its edible fruits.

*Chrysophyllum oliviforme* L. (?). *Zikiya*. La Libertad, *Lundell* 3501; *Aguilar* 396. A shrub or small tree; occasional in marginal forest and on limestone mounds.

*Dipholis salicifolia* (L.) A. DC. *Zitzya*. La Libertad, *Lundell* 3058, 3098, 3354, 3690. Occasional in the grasslands and on limestone hills. In the deep clay grasslands it is a small, scrubby, gnarled tree not more than 5 meters high, while in the forest on the limestone hills the same species is a handsome erect tree as much as 15 meters in height. The physiognomy is entirely different in the two habitats, yet there is no doubt that both forms represent the same species.

*Lucuma campechiana* HBK. *Zapotillo de montaña*. La Libertad, *Lundell* 3618. Medium-sized trees; occasional in the limestone valley forest of Monte Hiltun.

*Lucuma hypoglauca* Standl. *Mamey de Santo Domingo*. La Libertad, Lundell 3265; Aguilar 81. A large tree; cultivated for its fruits. I have not encountered it growing wild in the Yucatan Peninsula.

## OLEACEÆ

*Jasminum grandiflorum* L. *Jazmin*. La Libertad, Lundell 2806. Cultivated for ornament.  
*Jasminum pubescens* (Retz.) Willd. *Jazmin de novia*. La Libertad, Lundell 2802; Aguilar 155. Cultivated for ornament.

*Jasminum sambac* (L.) Ait. *Jazmin de Amelia*. La Libertad, Aguilar 82. Cultivated for ornament.

## LOGANIACEÆ

*Buddleia americana* L. La Libertad, Lundell 3105. A large shrub of marginal forest; not common.

## GENTIANACEÆ

*Lisianthus congestus* Standl. La Libertad, Lundell 2479, type collection. An herb about 1 meter high; collected on a mound in Chakantun.

*Schultesia lisianthoides* (Griseb.) Benth. & Hook. La Libertad, Lundell 2130. Herb on mounds in Chakantun.

## APOCYNACEÆ

*Aspidosperma megalocarpon* Muell. Arg. (?). La Libertad, Lundell 3692. A giant tree; occasional in limestone valley forest of Monte Hiltun.

*Cufodontia lundelliana* Woodson. La Libertad, Lundell 3408, type collection. A tree 15 meters high; collected on a hill cap; encountered only once.

*Forsteronia viridescens* Blake. La Libertad, Lundell 2540. Woody vine of flatland forest.

*Lochnera rosea* (L.) Reichenb. *Chula, Lila*. La Libertad, Lundell 2807. Cultivated ornamental herb.

*Mandevilla subsagittata* (R. & P.) Woods. La Libertad, Lundell 2333, 2363. Slender herbaceous vine of marginal forest.

*Mesechites trifida* (Jacq.) Muell. Arg. La Libertad, Lundell 2276, 3469. Herbaceous vine of marginal forest; collected also in the village.

*Nerium oleander* L. *Narciso*. La Libertad, Lundell 2803; Aguilar 137. Cultivated ornamental shrub.

*Plumeria acutifolia* Poir. *Nicte del monte, Matuhua, Flor de Mayo*. La Libertad, Lundell 2810, 2811, 2955. A low tree; much in evidence on the slopes of the limestone hills in April and May, when it flowers. The species is undoubtedly native in the area. Collections 2810 and 2811 were from yellow and white forms cultivated in the village. During festivals the flowers of this species and *P. rubra* are used extensively as decorations in churches and houses.

*Plumeria rubra* L. *Nicte chachac, Flor de Mayo*. La Libertad, Lundell 2822, 3023. A small tree; planted for ornament.

*Rauwolfia canescens* L. La Libertad, Lundell 2493, 3399; Aguilar 138. A shrub; collected in the village and in marginal forest; occasional.

*Rauwolfia canescens* L. var. *glabra* Mgf. La Libertad, Lundell 3467. A shrub; found in marginal forest.

*Stemmadenia galeottiana* (A. Rich.) Miers. *Ixlao, Ixdislan*. La Libertad, Lundell 2406, 3559. A small tree; apparently planted for ornament or for living fence posts.

*Stemmadenia grandiflora* (Jacq.) Miers. *Huevo de caballo*. La Libertad, Lundell 3444. Medium-sized trees, growing in old abandoned *milpas* at Polol.

*Tabernaemontana arborea* Rose. La Libertad, Aguilar 326.

*Tabernaemontana chrysocarpa* Blake. *Cojon de caballo, Lecheso*. La Libertad, Lundell 2354, 2505, 2845, 2897, 3106, 3228, 3278, 3433, 3468, 4868. A shrub or small tree; common in flatland forest, especially around *aguadas*.

*Thevetia ahouai* A. DC. *Cojon de perro*. La Libertad, Lundell 2421, 4062. An erect shrub; collected in village clearing and flatland forest. This is the plant previously reported from the Yucatan Peninsula as *Thevetia nitida* (HBK.) A. DC.

*Thevetia peruviana* (Pers.) K. Sch. *Acitz*. La Libertad, Lundell 3266; Aguilar 130. A large shrub; commonly planted in villages; its latex is used in treating toothaches.

*Urechites andrieuxii* Muell. Arg. La Libertad, *Lundell* 3445, 3533. An herbaceous vine; occasional in marginal forest.

#### ASCLEPIADACEÆ

*Asclepias curassavica* L. La Libertad, *Lundell* 2108, 2283, 3696. Perennial; common in inhabited clearings and well-drained grasslands.

*Asclepias glaucescens* HBK. La Libertad, *Lundell* 2178. Perennial; occasional in the well-drained grasslands.

*Asclepias longicornu* Benth. La Libertad, *Lundell* 3733. Perennial; occasional in the well-drained grasslands.

*Asclepias setosa* Benth. La Libertad, *Lundell* 2484, 3476, 3645. Perennial; common in the well-drained grasslands.

*Metastelma schlechtendalii* Dcne. La Libertad, *Lundell* 3562; *Aguilar* 124. Slender herbaceous vine of marginal forest.

*Vincetoxicum chrysanthum* (Greenm.) Standl. (?). *Iga bejuco*. La Libertad, *Aguilar* 307. Slender suffrutescent vine; collected in marginal forest.

#### CONVOLVULACEÆ

*Calonyction aculeatum* (L.) House. *Luna blanca*. La Libertad, *Aguilar* 330. A large herbaceous vine, growing in the village.

*Calonyction clavatum* Don. *Luna morada*. La Libertad, *Aguilar* 423. Herbaceous vine; collected in marginal forest.

*Evolvulus nummularius* L. *Hierba de pesar*. La Libertad, *Aguilar* 174. A creeping perennial; collected on denuded hills and in the village; used in domestic medicine.

*Evolvulus sericeus* Sw. La Libertad, *Lundell* 2297, 2382, 2386, 2747, 3654, 3675, 3676, 3680; *Aguilar* 44. A very common small perennial of the well-drained grasslands.

*Ipomœa asarifolia* (Desv.) R. & S. *Hierba del carbunco*. La Libertad, *Aguilar* 134, 234. Collected in and around Aguada El Progreso.

*Ipomœa trifida* (HBK.) Don. La Libertad, *Lundell* 3452. A small herbaceous vine; collected in marginal forest at Polol.

*Ipomœa tuxtlensis* House. *Quebracajeto*. La Libertad, *Aguilar* 309. Suffrutescent vine of marginal forest.

*Jacquemontia pentantha* (Jacq.) Don. La Libertad, *Aguilar* 94. A small herbaceous vine; collected at Polol.

*Merremia umbellata* (L.) Hallier. La Libertad, *Lundell* 2445. A yellow-flowered herbaceous vine; collected in the village.

*Operculina ornithopoda* (Robinson) House. La Libertad, *Lundell* 2477, 3504. Small herbaceous vine, growing on the limestone mounds in Chakantun.

*Operculina pectinata* House. La Libertad, *Lundell* 3491. A large herbaceous vine; occasional in marginal forest.

*Operculina tuberosa* (L.) Meissn. *Quinimacal*. La Libertad, *Aguilar* 438.

*Rivea corymbosa* (L.) Hallier. *Ixtaventun*, *Flor de Guadalupe*. La Libertad, *Aguilar* 427. An herbaceous vine; collected in marginal forest.

#### HYDROPHYLLACEÆ

*Hydrolea spinosa* L. *Meh*. La Libertad, *Aguilar* 473.

*Nama jamaicense* L. La Libertad, *Lundell* 3414. Common prostrate annual of inhabited clearings.

#### BORAGINACEÆ

*Cordia alliodora* (Ruiz. & Pav.) Cham. *Bojon*. La Libertad, *Aguilar* 493.

*Cordia collococca* L. La Libertad, *Lundell* 3416. A tree 8 to 12 meters high; common in the old abandoned milpas of Monte Chimah.

*Cordia dodecandra* DC. *Kopte*, *Siricote*. La Libertad, *Lundell* 2896. A medium-sized tree, growing in the village. The fruits are often made into "dulces" of exceptional quality.

*Cordia ferruginea* (Lam.) R. & S. La Libertad, *Aguilar* 86. A subscandent shrub of marginal forest.

*Cordia gerascanthus* L. La Libertad, Lundell 3603. A shrub of marginal forest.

*Cordia globosa* (Jacq.) HBK. La Libertad, Aguilar 171. Infrequent subshrub of the well-drained grasslands.

*Heliotropium filiforme* Lehm. La Libertad, Lundell 2521, 3632. Common small annual of the acid *aguada* basins.

*Heliotropium indicum* L. Chamico. La Libertad, Lundell 2168, 3030. A small annual; collected in a dry *aguada* basin and in inhabited clearings.

*Heliotropium parviflorum* (DC.) Griseb. Kusan, Golondrina. La Libertad, Lundell 3034; Aguilar 265. An annual around *aguadas*.

*Heliotropium procumbens* Mill. Rabillo. La Libertad, Lundell 2524, 3479; Aguilar 48. A small annual in and around dry *aguada* basins. Aguilar states that the plant is employed as a purgative and for treatment of indigestion.

*Tournefortia hirsutissima* L. La Libertad, Lundell 2104, 3396. Scandent shrub; occasional in marginal forest.

*Tournefortia hispidissima* L. La Libertad, Aguilar 49. Scandent shrub; occasional in flatland forest.

*Tournefortia peruviana* Poir. La Libertad, Lundell 3720. Scandent shrub; occasional in flatland forest.

*Tournefortia umbellata* HBK. (?). Zarahu. La Libertad, Aguilar 148. Subscandent shrub; occasional in the abandoned *milpas* of Monte Chimah. Dr. I. M. Johnston states that the material may represent an undescribed species.

#### VERBENACEÆ

*Bouchea prismatica* (L.) Kuntze. *Verbena*. La Libertad, Lundell 2171. Occasional annual of inhabited clearings.

*Callicarpa acuminata* HBK. *Ceniciento*. La Libertad, Lundell 2344, 3027, 3635, 3755; Aguilar 63. Common shrub of marginal forest.

*Clerodendron fragrans* Vent. *Jazmin de España*. La Libertad, Lundell 2408. Cultivated ornamental shrub.

*Clerodendron ligustrinum* (Jacq.) R. Br. *Muste*. La Libertad, Aguilar 353. Occasional shrub of marginal forest. Aguilar reports that the leaves are used to flavor fish.

*Cornutia latifolia* (HBK.) Moldenke. *Chialche*. La Libertad, Aguilar 54. A shrub or treelet of marginal forest; used in the treatment of fever.

*Cornutia pyramidata* L. var. *isthmica* Moldenke. La Libertad, Lundell 2252, 3450. A large shrub of marginal forest.

*Lantana camara* L. La Libertad, Lundell 2292, 2384, 2473. Occasional subshrub of the well-drained grasslands.

*Lantana trifolia* L. La Libertad, Lundell 3493; Aguilar 117. A rare subshrub of the well-drained grasslands.

*Lippia alba* (Mill.) N. E. Brown. *Oregano*. La Libertad, Aguilar 40. A shrub; apparently cultivated. Aguilar states that it is used "para guizados y contra el tetano."

*Lippia dulcis* Trev. *Malba*, *Orozus*. La Libertad, Lundell 2180, 3537, 3688. Common perennial of inhabited clearings.

*Lippia myriocephala* Schl. & Cham. *Maste*. La Libertad, Lundell 2119, 2599; Aguilar 394. Common small tree of marginal forest.

*Petrea volubilis* L. *Santa Rita*. La Libertad, Lundell 3431; Aguilar 362. A large woody vine; occasional in abandoned *milpas*. The species is often planted for ornament.

*Priva lappulacea* (L.) Pers. La Libertad, Lundell 3693. Common weedy annual of inhabited clearings.

*Stachytarpheta angustifolia* (Mill.) Vahl. La Libertad, Lundell 2519; Aguilar 198. An herb; common around *aguadas*.

*Stachytarpheta cayennensis* (L. Rich.) Vahl. *Verbena*. La Libertad, Aguilar 69. An herb; collected in the village.

*Vitex gaumeri* Greenm. *Yaxnic*, *Yaaxnic*. La Libertad, Lundell 3540. A large tree of flatland forest.

#### LABIATÆ

*Coleus blumei* Benth. *Hoja de color*. La Libertad, Lundell 2167. Cultivated ornamental herb.

*Hyptis americana* (Aubl.) Urban. La Libertad, Aguilar 227. An herb; collected on the bank of Aguada Yaxnic.

*Hyptis conferta* Pohl. var. *angustifolia* Benth. *Amor seco de campo*. La Libertad, Lundell 2279, 2568; Aguilar 88, 404. An occasional coarse herb of the well-drained grasslands.

*Hyptis pectinata* (L.) Poit. *Salada*. La Libertad, Lundell 2489; Aguilar 393. A tall herb; collected on a mound in Chakantun and in the well-drained grasslands.

*Hyptis suaveolens* (L.) Poit. La Libertad, Aguilar 85. An annual of the well-drained grasslands.

*Hyptis verticillata* Jacq. *Yerba Martin*. La Libertad, Lundell 2173, 3525. A coarse herb, growing in the village. A decoction with salt is used to relieve coughing.

*Leonotis nepetæfolia* (L.) R. Br. La Libertad, Lundell 2174; Aguilar 139. A tall coarse herb, growing in a drained sinkhole within the village.

*Marsypianthes chamædrys* (Vahl) Ktze. La Libertad, Lundell 3699. A small herb; occasional in the well-drained grasslands near Chiche.

*Ocimum micranthum* Willd. *Albake*, *Albahaca*, *Albahaca cimarrona*. La Libertad, Lundell 2370, 3735; Aguilar 103, 145. An annual; collected in the well-drained grasslands and the village. In regard to the plant, Aguilar states: "para malas vientos que ocasionan enfermedad."

*Salvia coccinea* L. var. *pseudococcinea* Gray. La Libertad, Lundell 3756; Aguilar 106. A common herb of inhabited clearings; apparently cultivated in some instances; used in domestic medicine.

*Salvia riparia* Kunth. La Libertad, Aguilar 298. An herb, growing in the village; used in the treatment of boils.

*Scutellaria* sp. La Libertad, Lundell 3614. A rare small herb of the well-drained grasslands.

#### SOLANACEÆ

*Brunfelsia nitida* Benth. *Gallan*. La Libertad, Lundell 2417. A small tree; planted for ornament.

*Capsicum annuum* L. *Chile grande*. La Libertad, Aguilar 78. Cultivated extensively.

*Capsicum baccatum* L. La Libertad, Aguilar 177. A cultivated herb, concerning which Aguilar states: "para dolor de estomago mesclado con limon agrio."

*Capsicum frutescens* L. *Chile largo*, *Picante*, *Chile pico de paloma*. La Libertad, Aguilar 64, 199. Commonly cultivated.

*Capsicum petenense* Standl. *Chile dulce*. La Libertad, Lundell 3754, type collection. Cultivated herb.

It is remarkable to discover an undescribed species among such plants.

*Datura candida* (Pers.) Pasq. *Campana*. La Libertad, Lundell 3729. A large shrub; planted for ornament.

*Lycianthes variifolia* Standl. La Libertad, Lundell 2331; Aguilar 258. A large subshrub; collected in marginal forest.

*Nicotiana tabacum* L. *Tabaco*. La Libertad, Lundell 3328. Cultivated and occasionally found as an escape.

*Physalis pubescens* L. *Tomatillo*. La Libertad, Aguilar 51. A weedy annual of inhabited clearings and *acahuales*. The fruit is said to be edible.

*Solanum aculeatissimum* Jacq. *Berenjena*. La Libertad, Lundell 3032. A shrub, growing around the *aguada* at Polol.

*Solanum diversifolium* Schlecht. *Baxbalum*, *Berenjena*. La Libertad, Lundell 2175, 2559, 3341; Aguilar 119. A common prickly shrub around *aguadas*.

*Solanum hirtum* Vahl. La Libertad, Lundell 2177, 3998. A subshrub, growing in the village.

*Solanum lanceifolium* Jacq. La Libertad, Lundell 3517. A woody vine; occasional in marginal forest.

*Solanum mammosum* L. *Chuchou*, *Berenjena*. La Libertad, Lundell 3031. A large herb, growing in the Polol settlement.

*Solanum seafortianum* Andr. *Lagrima de la Virgin*. La Libertad, Lundell 2411. A scandent shrub; cultivated for ornament.

*Solanum verbascifolium* L. *Tobaco lobo*. La Libertad, Aguilar 461.

*Solanum wendlandii* Hook. f. *Chiche*, Lundell 2751; La Libertad, Lundell 2984. Cultivated for ornament.

#### SCROPHULARIACEÆ

*Bacopa procumbens* (Mill.) Greenm. La Libertad, Lundell 3641, 3724. A decumbent perennial herb of the well-drained grasslands; occasional.

*Bacopa rotundifolia* (Michx.) Wettst. La Libertad, Aguilar 179. An herb; collected in Aguada El Progreso.

*Buchnera lithospermifolia* HBK. La Libertad, Lundell 3743. Slender perennial; occasional in the well-drained grasslands.

*Buchnera pusilla* HBK. La Libertad, Lundell 2304, 2310, 2397, 2458. A slender perennial; common in the well-drained grasslands.

*Capraria biflora* L. *Esclaviosa*. La Libertad, Aguilar 123. Common weedy herb of inhabited clearings. Concerning it Aguilar states: "para el paludismo, y para hacer profundo el sueño poniendo una ramita debajo de la almohada."

*Escobedia laevis* Cham. & Schl. La Libertad, Aguilar 75. An herb; collected in Sabana Poputilum.

*Russelia campechiana* Standl. La Libertad, Aguilar 464.

*Russelia flavoviridis* Blake. La Libertad, Lundell 2457, 3507. Perennial; occasional on mounds in Chakantun.

*Scoparia dulcis* L. *Mastuerzo*. La Libertad, Lundell 2582; Aguilar 140. An herb, growing in dry aguada basins and in the grasslands.

*Stemodia verticillata* (Mill.) Hassler. La Libertad, Lundell 3415. Small herb.

## MARTYNIACEÆ

*Martynia annua* L. *Uña de gato*. La Libertad, Aguilar 144. Coarse herb, growing in inhabited clearings.

## BIGNONIACEÆ

*Arrabidaea lundellii* Standl. La Libertad, Aguilar 267. Occasional liana of marginal forest; used for cordage.

*Crescentia cujete* L. *Luch*, *Calabaza*. La Libertad, Lundell 2325, 3279. Occasional small tree in the well-drained grasslands. The gourd-like fruits are used extensively for making utensils.

*Godmania xsculifolia* (HBK.) Standl. La Libertad, Aguilar 279.

*Lundia dicheilocalyx* Blake. (?). *Lux*, *Makalis*. La Libertad, Lundell 3447; Aguilar 259. Large liana; collected in flatland forest at Polol.

*Saldanhoa costaricensis* Kranzl. La Libertad, Lundell 3436. Large liana; found in the abandoned milpas of Monte Chimah.

*Tabebuia chrysantha* (Jacq.) Nichols. La Libertad, Lundell 3407. A tree 15 meters high; collected on a hill cap; rare. When the collection was made late in May, the large beautiful yellow flowers completely covered the crown of the leafless tree. The sapwood of the species is yellow and the heartwood black.

*Tabebuia pentaphylla* (L.) Hemsl. *Makalis*. La Libertad, Lundell 3282. A small tree, growing in the village.

## ACANTHACEÆ

*Aphelandra deppeana* Schl. & Cham. La Libertad, Lundell 3004. A shrub; encountered occasionally on hills.

*Blechnum pyramidatum* (Lam.) Urban. *Corrimiento*. La Libertad, Lundell 2170; Aguilar 192. Perennial herb.

*Dicliptera mollis* M. & S. *Salvina*. La Libertad, Aguilar 417. An herb; collected in marginal forest.

*Elytraria bromoides* Ørst. La Libertad, Lundell 2395, 2471; Chiche, Lundell 3708. Small perennial of well-drained grasslands; quite common late in May.

*Jacobinia spicigera* (Schl.) L. H. Bailey. *Añil*. La Libertad, Lundell 2415. A shrub; occasionally cultivated.

*Jacobinia umbrosa* (Benth.) Blake. *Copote de cambul*, *Pot de cambul*. La Libertad, Lundell 2864. Cultivated ornamental shrub.

*Ruellia geminiflora* HBK. *Violeta del campo*. La Libertad, Lundell 2286, 3485, 3581, 3672. Common perennial of the well-drained grasslands.

*Stenandrium guatemalense* Leonard. La Libertad, Lundell 3539, 3626, 3679. Occasional perennial of the well-drained grasslands.

*Stenandrium subcordatum* Standl. *Violetita*. La Libertad, Lundell 2295. Rare perennial of the well-drained grasslands.

*Thunbergia fragrans* Roxb. *Mariquita*. La Libertad, Aguilar 375. Cultivated ornamental vine.



## PLANTAGINACEÆ

*Plantago major* L. *Llanten*. La Libertad, Aguilar 407. Common perennial of inhabited clearings.

## RUBIACEÆ

*Alibertia edulis* (L. Rich.) A. Rich. *Pichipche*, *Guayabillo*. La Libertad, Lundell 3080, 3082, 3206, 3342; Aguilar 46. Very common tall shrub of flatland forest.

*Alseis yucatanensis* Standl. *Dzon*. La Libertad, Lundell 3434, 3758. Occasional tall tree of flatland forest; collected at Polol and in Monte Chimah.

*Borreria laevis* (Lam.) Griseb. *Palis*. La Libertad, Aguilar 52, 98. An herb of the well-drained grasslands; used in domestic medicine.

*Borreria ocimoides* (Burm. f.) DC. *Palitaria*. La Libertad, Lundell 2483; Aguilar 195. Occasional herb of well-drained grasslands and inhabited clearings.

*Borreria suaveolens* Mey. La Libertad, Lundell 2299, 2376; Aguilar 136. Perennial of the well-drained grasslands.

*Cephaelis tomentosa* (Aubl.) Vahl. *Madre*. Chiche, Lundell 1647; La Libertad, Lundell 3602, 4888. Common forest shrub.

*Chiococca alba* (L.) Hitchc. La Libertad, Lundell 2351; Aguilar 316. A liana of marginal forest.

*Coccocypselum hirsutum* Bartl. La Libertad, Aguilar 135. An herbaceous vine; collected in well-drained grasslands.

*Coffea arabica* L. *Cafe*. La Libertad, Lundell 2322; Aguilar 359, 360. Cultivated to a limited extent in orchards of the village.

*Diodia sarmentosa* Sw. La Libertad, Lundell 2187, 3050. An herbaceous scrambler; occasional in marginal forest.

*Geophila herbacea* (Jacq.) Schum. *Zapillo*. La Libertad, Lundell 3495, 3590; Aguilar 147. Small prostrate herb, forming mats on the floor of limestone valley forest.

*Guettarda combsii* Urban. *Texpac*, *Textop*. La Libertad, Lundell 2964, 2970, 3092, 3509, 4431; Aguilar 114. Common shrub or small tree of hill and flatland forest. The species has been previously reported from the Yucatan Peninsula as *G. seleriana* (Loes.) Standl., a synonym.

*Guettarda elliptica* Sw. La Libertad, Lundell 3329. A shrub or treelet of marginal forest.

*Guettarda gaumeri* Standl. *Zedi*. La Libertad, Aguilar 312. A shrub; collected in marginal forest. Aguilar states that the fruits are edible.

*Hamelia patens* Jacq. *Ixkanan*, *Ixkanan amarillo*. La Libertad, Lundell 3103; Aguilar 10, 39. Occasional shrub of marginal forest and inhabited clearings; an infusion is used to wash boils and wounds.

*Hemidiodia ocimifolia* (Willd.) Schum. La Libertad, Lundell 3698. An herb of the well-drained grasslands.

*Machaonia acuminata* Humb. & Bonpl. La Libertad, Aguilar 11. A shrub; collected in marginal forest.

*Morinda yucatanensis* Greenm. *Bejuco piñoncillo*. La Libertad, Lundell 2569, 3492; Aguilar 276. A liana; occasional on the hills and in marginal forest, rare in the grasslands.

*Oldenlandia herbacea* (L.) DC. La Libertad, Lundell 2583. A small herb; collected in a dry aguada basin.

*Palicourea galeottiana* Martens. La Libertad, Aguilar 306. A shrub; probably collected in marginal forest.

*Palicourea guianensis* Aubl. *Bitcul*. La Libertad, Lundell 3460; Aguilar 302. Occasional shrub of marginal forest.

*Psychotria flava* (Erst.) La Libertad, Lundell 3437, 3489. A shrub of flatland forest.

*Psychotria granadensis* Benth. La Libertad, Lundell 2466, 2563, 2855, 3506. Common shrub on *rendzina* soils.

*Psychotria horizontalis* Sw. La Libertad, Lundell 3076, 3372, 3563, 3629, 3726; Aguilar 260. Very common low shrub in flatland high forest, occasional in other habitats.

*Psychotria marginata* Sw. *Ookan cimarron*. La Libertad, Lundell 3584. A common large shrub of limestone valley of Monte Hiltun.

*Psychotria pubescens* Sw. La Libertad, Lundell 3462, 3617. Occasional shrub of limestone valley and marginal forest.

*Psychotria sessilifolia* Mart. & Gal. La Libertad, Lundell 2263. A shrub of marginal forest.

*Psychotria undata* Jacq. La Libertad, Lundell 3374; Aguilar 292. Common low shrub of hill and flatland forest.

*Randia aculeata* L. La Libertad, *Lundell* 2224. A low shrub in marginal forest.

*Randia albonervia* Brandege. *Luchmaax*. La Libertad, *Lundell* 3362. Occasional low gnarled tree of marginal forest.

*Randia malacocarpa* Standl. *Chaxin*. La Libertad, *Lundell* 3417, 3474, 3496. A low shrub in flatland forest.

*Randia monantha* Benth. (?). *Luchmaax*. La Libertad, *Lundell* 3003. Small gnarled tree of marginal forest.

*Richardia scabra* L. Chiche, *Lundell* 3705; La Libertad, *Aguilar* 57, 152. An herb of grasslands and marginal forest.

*Rondeletia belizensis* Standl. *Chakanche*. La Libertad, *Lundell* 2854, 3210, 3352; *Aguilar* 28. Small slender tree; very common on hill caps and in marginal forest.

*Rudgea ceratopetala* Donn. Sm. La Libertad, *Lundell* 3585. A shrub; much in evidence in the limestone valley forest of Monte Hiltun.

*Sickingia salvadorensis* (Standl.) Standl. *Chacahuante*, *Chactemuch*, *Palo colorado*. La Libertad, *Lundell* 3621. Tall tree in limestone valley forest of Monte Hiltun.

## CAPRIFOLIACEÆ

*Sambucus mexicana* Presl. *Sanco*. La Libertad, *Lundell* 2416. Planted for ornament.

## VALERIANACEÆ

*Valeriana mikaniæ* Lindl. La Libertad, *Aguilar* 471.

## CUCURBITACEÆ

*Cayaponia racemosa* (Sw.) Cogn. La Libertad, *Lundell* 2516. Herbaceous vine; collected along a fence row in the village.

*Cucurbita moschata* Duch. *Kuum*, *Calabaza*. La Libertad, *Lundell* 2981, 4268. Cultivated extensively.

*Cucurbita radicans* Naud. *Bulot*. La Libertad, *Lundell* 3558. Common herbaceous vine of inhabited clearings. The specific determination is doubtful.

*Lagenaria leucantha* (Lam.) Rusby. *Bux de campo*. La Libertad, *Aguilar* 178. An herbaceous vine, growing in the well-drained grasslands; used in the treatment of stomach disorders.

*Lagenaria siceraria* (Molina) Standl. La Libertad, *Lundell* 3943, 4267. A large herbaceous vine, growing in the grasslands around the Polol settlement. The species is commonly planted with *Cucurbita moschata* in milpas.

## LOBELIACEÆ

*Isotoma longiflora* (L.) Presl. *Ilusion*. La Libertad, *Lundell* 2642. Small perennial; generally found in inhabited clearings.

## COMPOSITÆ

*Ageratum corymbosum* Zuccag. var. *latifolium* (DC.) Robinson. La Libertad, *Lundell* 2387; *Aguilar* 15. Occasional herb of the well-drained grasslands.

*Artemisia mexicana* Willd. *Incienso*. La Libertad, *Aguilar* 67. A coarse herb, growing in the village; used in the treatment of colic.

*Baccharis trinervis* (Lam.) Pers. La Libertad, *Aguilar* 478.

*Bidens pilosa* L. La Libertad, *Aguilar* 80. An herb; collected around Aguada El Progreso.

*Bidens squarrosa* HBK. La Libertad, *Aguilar* 214, 231. A large scrambler; collected in marginal forest.

*Brickellia diffusa* (Vahl) Gray. *Visquita*. La Libertad, *Aguilar* 414. An herb, growing in the village.

*Brickellia oliganthes* (Less.) Gray. La Libertad, *Lundell* 2472. Small perennial of the well-drained grasslands.

*Calea urticifolia* (Mill.) DC. La Libertad, *Lundell* 2109. Large suffrutescent plant, growing in marginal forest.

*Calea zacatechichi* Schlecht. La Libertad, *Lundell* 2488. A suffrutescent plant; collected in the well-drained grasslands.

*Chaptalia nutans* (L.) Polak. *Valeriana*. La Libertad, *Lundell* 2453, 3652, 3689; *Aguilar* 118; Chiche, *Lundell* 3717. A common small herb of the well-drained grasslands; it makes its appearance soon after the first rains in May.

*Cirsium chrismarii* (Klatt) Petrak. (?). La Libertad, Lundell 2462. A tall herb, growing on the limestone mounds in Chakantun.

*Cirsium mexicanum* DC. Cardosanto macho. La Libertad, Aguilar 347. A coarse herb; collected on the limestone mounds in Chakantun.

*Clibadium arboreum* Donn. Sm. La Libertad, Aguilar 322. Large suffrutescent plant of marginal forest.

*Elephantopus hypomalacus* Blake. (?). Chiche, Lundell 3700. Small herb, growing in the well-drained grasslands.

*Elephantopus mollis* HBK. La Libertad, Lundell 2251, 2285; Aguilar 97, 189. Common herb of well-drained grasslands and marginal forest.

*Erigeron bonariensis* L. Artemisa, Fabaguillo. La Libertad, Lundell 4876; Aguilar 115. Small herb, growing in the village and in the well-drained grasslands.

*Erigeron jamaicensis* L. Chiche, Lundell 3709. Slender herb of the well-drained grasslands.

*Erechtites hieracifolia* (L.) Raf. La Libertad, Aguilar 207. An herb; collected in the village.

*Eupatorium albicaule* Sch. Bip. Ixhotz. La Libertad, Lundell 2971, 3538; Aguilar 17; Chiche, Lundell 3718. Common suffrutescent scrambler of marginal forest.

*Eupatorium iwæfolium* L. La Libertad, Aguilar 270.

*Eupatorium macrocephalum* Less. Macedon. La Libertad, Aguilar 113. Coarse herb; collected in Sabana Popuctilum; used to treat headaches.

*Eupatorium macrophyllum* L. La Libertad, Aguilar 18. A large coarse herb, growing in the village; an infusion of the plant is used to wash wounds.

*Eupatorium morifolium* Mill. Chople. La Libertad, Lundell 2125, 2927, 3055. Common large suffrutescent plant of marginal forest.

*Eupatorium odoratum* L. La Libertad, Lundell 2361; Aguilar 16. Large scrambler of marginal forest.

*Eupatorium cerstedianum* Benth. La Libertad, Lundell 3604. A shrub; collected in marginal forest.

*Liabum subglandulare* Blake. Zos blanco, Talco. La Libertad, Aguilar 484.

*Melanthera angustifolia* A. Rich. La Libertad, Lundell 2490, 3651; Aguilar 4, 112. Occasional perennial of the well-drained grasslands.

*Montanoa pauciflora* Klatt. La Libertad, Aguilar 476.

*Neurolæna lobata* (L.) R. Br. La Libertad, Lundell 2121. Occasional tall herb in marginal forest.

*Notoptera scabridula* Blake. La Libertad, Aguilar 297. Suffrutescent scrambler in marginal forest.

*Orthopappus angustifolius* (Sw.) Gleason. La Libertad, Aguilar 301. An herb; collected in the well-drained grasslands.

*Parthenium hysterophorus* L. La Libertad, Lundell 3730. Common weedy herb of inhabited clearings.

*Pectis elongata* HBK. Cominillo. La Libertad, Aguilar 170. An herb; collected in the well-drained grasslands; used in the treatment of fever.

*Perymenium peckii* Robinson. La Libertad, Aguilar 344. Suffrutescent scrambler; collected in marginal forest.

*Podachænum eminens* (Lag.) Sch. Bip. La Libertad, Aguilar 474.

*Pseudelephantopus spicatus* (Juss.) Rohr. Codillo, Lengua de vaca. La Libertad, Lundell 2169, 3042, 3457; Aguilar 186. Common herb in inhabited clearings, occasional in flatland forest.

*Salmea scandens* (L.) DC. La Libertad, Lundell 2112. Scandent suffrutescent plant in marginal forest.

*Senecio confusus* Britten. La Libertad, Aguilar 121. A vine, growing in the village.

*Spilanthes americana* (Mutis) Hieron. La Libertad, Aguilar 413. An herb; collected in the village.

*Struchium sparganophorum* (L.) Kuntze. La Libertad, Lundell 2530. Common perennial herb around aguadas.

*Synedrella nodiflora* (L.) Gærtn. La Libertad, Aguilar 410. An herb; collected in the village.

*Tagetes erecta* L. Ixtupug, Sanpuel. La Libertad, Aguilar 150. An herb, growing in the village; used in domestic medicine.

*Tagetes schiedeana* Less. Pericon. La Libertad, Aguilar 58. An herb; collected in Sabana Popuctilum; used in the treatment of stomach disorders.

*Tithonia pittieri* (Greenm.) Blake. La Libertad, Aguilar 472.

*Trichospira menthoides* HBK. La Libertad, Lundell 3029, 3335; Aguilar 38. Common prostrate annual in dry aguada basins.

*Tridax procumbens* L. La Libertad, Lundell 2454, 3280. Small herb of the well-drained grasslands and limestone mounds.

*Trixis radialis* (L.) Kuntze. La Libertad, Lundell 2103, 2422, 3028. Suffrutescent plant with long slender stems; occasional in marginal forest and around the inhabited clearings.

*Verbesina giganteoides* Robinson. Chulque. La Libertad, Aguilar 232. Large coarse herb; collected in marginal forest.

*Vernonia aschenborniana* Schauer. La Libertad, Lundell 2114, 2226, 2561; Aguilar 355, 408. Very common woody scrambler of the marginal forest.

*Vernonia tortuosa* (L.) Blake. La Libertad, Lundell 2110, 2572; Aguilar 383. Common large woody scrambler of marginal forest.

*Wedelia parviceps* Blake. La Libertad, Lundell 3623. Common perennial in the swampy grasslands of Sabana Zotz.

*Zermeria frutescens* (Mill.) Blake. Sos negro. La Libertad, Aguilar 426. A scrambler; collected in marginal forest.

### SOUTHERN PETÉN

Southern Petén comprises practically half of the entire Department. According to Sapper (1894) it is a "subsidence basin" covered with beds of Tertiary limestone. Although most of the region is only slightly undulating, some sections are quite hilly. Drainage is chiefly through the Rio Pasion, Rio Salinas, and their tributaries.

No meteorological records are available, but from the vegetation we can assume that the rainfall at least equals that of Northern Petén and possibly may be somewhat greater. The entire region, except small pine areas in the vicinity of Dolores, is covered with luxuriant broad-leaved forest.

Southern Petén still remains botanically unexplored; only three small collections of plants have been made in the region. In April 1933 the writer spent a few days studying the vegetation at Santa Teresa and along Rio Subin (Plate 1). Mr. W. C. Schipp's 1934 collections from the British Honduras-Guatemala border in southeastern Petén may be considered as part of the southern Petén flora. Aguilar collected along Rio Pasion in 1935. In the annotated list (p. 195) I include my collections and Aguilar's from the area and those border collections of Mr. Schipp which are represented in the Herbarium of the University of Michigan.

From the collections it is evident that there is a considerable element of the Yucatan flora present in certain areas south of the savanna country of central Petén. Mr. Schipp's collections reveal that the southeastern Petén flora is allied to that of southern British Honduras and southern Guatemala.

The following discussion of the vegetation covers only a strip of Monte Santa Teresa and a section of about one kilometer along Rio Subin (Plate 1) in the vicinity of Santa Teresa, the *rancho* of Mr. O. A. Taintor.

### SUBIN RIVER AND BANKS

The river is a small stream of coffee-colored water emptying into the Rio Pasion below Sayaxche. Its aquatic vegetation is luxuriant and abundant (Plate 39). The floating water hyacinth, *Eichhornia crassipes*, completely blocks that portion not kept open by water traffic. With the water hyacinth grow such other common free-floating species as the *lechuga* or *xicinchah*, *Pistia stratiotes*, the fern, *Salvinia rotundifolia*, *Lemna* sp., and the liverwort, *Ricciocarpus natans*.

The only submerged aquatic observed is the widely distributed *Cabomba aquatica*, sometimes called *uchul*.

In the shallow still water where *Eichhornia crassipes* is not prominent, there are patches of the *nohoch naab*, *Nymphæa ampla*. Several plants of the *naab mejen*, *Hydrocotyle umbellata*, were found in the same habitat. *Pontederia lanceolata* grows in inlets and along the muddy banks, but it is not as prominent as either *Eichhornia* or *Nymphæa*.

On the muddy banks in spots not too shaded grow large dense patches of *Panicum trichanthum* and smaller ones of *Justicia comata*. In these are to be found occasional plants of the subscandent composite, *Harleya oxylepis*.

The low marshy areas along the river bank, generally narrow and limited in extent, are overgrown with sedges, among which are *Cyperus ochraceus* and *C. virens*. *Eleocharis interstincta* grows in the habitat and in shallow water along the edge.

Bordering the river grow the characteristic moisture-loving riparian trees, *Bucida buceras*, *Pachira aquatica*, and *Inga edulis*, the first a giant, the last two generally not exceeding 10 meters in height. In with them I collected one other tree, *Homalium hondurensense*, and two lianas, *Combretum mexicanum* and *Petastoma ocositense*. Under the trees of the river edge grow thickets of the terribly spiny species of *Bactris*.

Along the river bank for considerable stretches, the forest growth is completely veiled by a dense covering of the herbaceous leguminous vine, *Vigna repens* (Plate 39). It forms a veritable blanket, extending even over the tree crowns.

Inland on somewhat higher banks grow the giant *corozo* palms, *Orbignya cohune* and *Scheelea lundellii*, known respectively as *tutz* and *kantutz*.

The Subin River is a narrow stream so that branches of the larger trees extend almost across it to the opposite bank. On these branches overhanging the river and on the tree trunks themselves, epiphytes abound. Of the epiphytes I collected three ferns, *Asplenium auritum*, *Polypodium costatum*, and *Nephrolepis pendula*; two orchids, *Camaridium pulchrum* and *Epidendrum imatophyllum*; one cactus, *Epiphyllum crenatum*; five bromelioids, *Æchmea bracteata*, *Tillandsia filifolia*, *T. pruinosa*, *T. valenzuelana*, and *Billbergia viridiflora*; and three aroids, *Anthurium tetragonum* var. *yucatanense*, *Anthurium scandens* (?), and *Philodendron smithii*.

In the systematic list which follows, I include all the aquatics and bank species collected or noted in the short stretch along the Subin River. The collection numbers are those of the writer.

#### TREES:

Palmæ	<i>Orbignya cohune</i> (Mart.) Dahlgren. <i>Tutz</i> , Corozo.
	<i>Scheelea lundellii</i> Bartlett. <i>Kantutz</i> , Corozo.
Leguminosæ	<i>Inga edulis</i> Mart. <i>Uatop</i> , Bitze. 2676.
Bombacaceæ	<i>Pachira aquatica</i> Aubl. <i>Uacoot</i> , Zapotebobo. 2664.
Flacourtiaceæ	<i>Homalium hondurensense</i> Blake. 2663.
Combretaceæ	<i>Bucida buceras</i> L. 2785.

## SHRUBS OR TREELETS:

- Palmae *Bactris* sp. *Jauacte*. 2655.  
*Bactris* sp. *Jauacte*. 2655A.

## LIANAS:

- Combretaceae *Combretum mexicanum* Humb. & Bonpl. 2675.  
 Bignoniaceae *Petastoma ocositense* (D. Sm.) Kranzl. 2659.

## HERBACEOUS VINES:

- Leguminosae *Vigna repens* (L.) Kuntze. 2660.

## HERBS:

- Salviniaceae *Salvinia rotundifolia* Willd. 2756, 3019.  
 Gramineae *Panicum trichanthum* Nees. Sooc. 2760.  
 Cyperaceae *Cyperus ochraceus* Vahl. 2657.  
*Cyperus virens* Michx. 2658.  
*Eleocharis interstincta* (Vahl) R. & S. Polol. 2656.  
 Lemnaceae *Lemna* sp. 3020.  
 Araceae *Pistia stratiotes* L. *Xicinchah*, *Lechuga*. 2666.  
 Pontederiaceae *Eichhornia crassipes* (Mart.) Solms. *Ninfa*. 2665.  
*Pontederia lanceolata* Nutt. 2709.  
 Nymphaeaceae *Cabomba aquatica* Aubl. *Uchul*. 2755.  
*Nymphaea ampla* (Salisb.) DC. *Nohoch naab*, *Nape*. 2759.  
 Umbelliferae *Hydrocotyle umbellata* L. *Naab mejen*. 2757.  
 Acanthaceae *Justicia comata* (L.) Lam. 2761.  
 Compositae *Harleya oxylepis* (Benth.) Blake. 2672.

## EPIPHYTES:

- Polypodiaceae *Asplenium auritum* Sw. 2788.  
*Nephrolepis pendula* (Raddi) J. Sm. 2752, 2758, 2816.  
*Polypodium costatum* Kunze. 2786.  
 Bromeliaceae *Æchmea bracteata* (Sw.) Griseb.  
*Billbergia viridiflora* Wendl. 2653.  
*Tillandsia filifolia* Cham. & Schl. 2680.  
*Tillandsia pruinosa* Sw. 2900.  
*Tillandsia valenzuelana* A. Rich. 2674, 2793.  
 Araceae *Anthurium scandens* (Aubl.) Engl. (?). 2671.  
*Anthurium tetragonum* Hook. var. *yucatanense* Engl. 2708, 2889.  
*Philodendron smithii* Engl. 2888.  
 Orchidaceae *Camaridium pulchrum* Schl. 2978.  
*Epidendrum imatophyllum* Lindl. 2670.  
 Cactaceae *Epiphyllum crenatum* (How.) Don. *Pitaya*. 2901.

## OLD FOREST OF THE WELL-DRAINED UPLANDS

The high forest on the well-drained uplands of Monte Santa Teresa (fig. 1) is in physiognomy quite similar to the forest of Northern Petén. Three tree tiers and a shrub layer may be distinguished. Although the flora is much the same as in the limestone region north of Lake Petén, in the matter of dominants there is a noticeable difference. In the first place, *Achras zapota* is uncommon, there being only occasional small to medium-sized trees. Most of the mahogany has been logged so that it is not much in evidence. It was not possible in the limited time at the writer's disposal to determine which species or group of species are actually dominant. However, from the limited observations, *Dialium guianense*, *Calophyllum brasiliense* var. *rekoi*, *Vitex gaumeri*, and *Swietenia macrophylla* appeared among the characteristic trees.

Although there are few data to back the assumption, I am of the opinion that the forest of Monte Santa Teresa is only sub-climax. It is probable that all

of this area was cleared for *milpas* when Chakantun (fig. 1) was occupied (Lundell, 1934a), and possibly in subsequent years. If so, the forest has not had sufficient time to reach the climax stage, whatever that may be.

The black calcareous soils of Monte Santa Teresa may all be classed as *rendzina*. Although they are often several feet in depth over long stretches of the uplands, outcropping limestone is not uncommon in the area. On this type of soil in Northern Petén the climax formation is typified primarily by *Achras zapota*. The fact that scattered small and medium-sized trees of this species are present is evidence that it is now firmly established. The *zapote* may become the outstanding dominant if the area is left undisturbed for sufficient time.

The trees of the top tier, reaching a height of from 35 to 40 meters, include the *cantemec*, *Acacia glomerosa* (?); the *chate*, *Dialium guianense*; the *caoba*, *Swietenia macrophylla*; the *lechillo*, *Sideroxylon lundellii*; the *yaxnic*, *Vitex gaumeri*; and *Calophyllum brasiliense* var. *rekoi*. To the middle tier I assign the *botan* palm, *Sabal* sp.; the giant *guarumo*, *Cecropia mexicana*, *Pera barbellata*; the *chulte*, *Bombax ellipticum*; *Oreopanax guatemalense*; the *zapote*, *Achras zapota*, and *Linociera oblanceolata*. In the lower tree tier, which seldom exceeds 10 meters in height, are to be found the thorny *escoba* palm, *Cryosophila argentea*, *Cymbopetalum penduliflorum*, *Ouratea peckii*, *Rinorea hummelii*, *Casearia nitida*, *Hasseltia dioica*, *Miconia impetiolaris*, and *Symplocos martinicensis*.

Shrubs are abundant with species of Piperaceæ and Rubiaceæ most amply represented. I collected the *moxan*, *Geonoma mexicana*, *Piper instabilipes*, *Cephaelis tomentosa*, and *Psychotria chiapensis*.

Among the most interesting lianas is the giant *Clusia lundellii* which reaches to the top of the tallest trees. It probably starts as a hemi-epiphyte. Other lianas collected are the *sahaak*, *Tetracera volubilis* (?), and *Serjania atrolineata*. A scrambler, *Eupatorium* sp., was also encountered.

Herbaceous growth is represented by numerous ferns, a few shade-tolerant grasses, and other typical forest forms such as species of *Costus*. In a spot where light penetrated to the floor, I found a dense patch of ferns containing *Adiantopsis radiata*, *Adiantum decoratum*, *A. latifolium*, *A. petiolatum*, *A. pulverulentum*, *Dryopteris melanosticta*, *D. obliterated*, *Pteris altissima*, and *P. pungens*. The prostrate *Selaginella guatemalensis* was common. Of the grasses I collected *Ichnanthus pallens*, *Olyra yucatana*, and *Oplismenus hirtellus*. In a wet place along the shaded road the *navajuello*, *Rynchospora cephalotes*, was much in evidence. The *cooltze*, *Costus spicatus*, is met with occasionally.

Of the epiphytes, *Trichomanes godmani*, *Billbergia viridiflora*, *Tillandsia canescens*, *Epidendrum cochleatum*, *Pleurothallis brighami*, *Peperomia pololensis*, *P. rotundifolia*, and *Rhipsalis coriacea* were collected.

All the collections in the high forest of Monte Santa Teresa are included in the following list. The collection numbers are those of the writer, unless otherwise indicated.



## THIRD-STORY TREES:

- Leguminosæ *Acacia glomerosa* Benth. (?). *Cantemoc*. 2812.  
*Dialium guianense* (Aubl.) Steud. *Chate*. 2687.  
 Meliaceæ *Swietenia macrophylla* King. *Caoba*.  
 Clusiaceæ *Calophyllum brasiliense* Camb. var. *reko*i Standl. 2771.  
 Sapotaceæ *Sideroxylon lundellii* Standl. *Lechillo*. 2767.  
 Verbenaceæ *Vitex gaumeri* Greenm. *Yaxnic*. 2662.

## SECOND-STORY TREES:

- Palmæ *Sabal* sp. *Botan*.  
 Moraceæ *Cecropia mexicana* Hemsl. *Guarumo*. 2891.  
 Euphorbiaceæ *Pera barbellata* Standl. 2686.  
 Bombacaceæ *Bombax ellipticum* HBK. *Chulte*. 2681.  
 Araliaceæ *Oreopanax guatemalense* (Lem.) Dcne. & Planch. 2906.  
 Sapotaceæ *Achras zapota* L. *Zapote*.  
 Oleaceæ *Linociera oblanceolata* Robinson. 2692.

## FIRST-STORY TREES:

- Palmæ *Cryosophila argentea* Bartlett. *Akuum*, *Escoba*. 2669.  
 Annonaceæ *Cymbopetalum penduliflorum* (Dun.) Baill. 2950.  
 Ochnaceæ *Ouvatea peckii* Riley. 2719.  
 Violaceæ *Rinorea hummelii* Sprague. 2683, 2763.  
 Flacourtiaceæ *Casearia nitida* (L.) Jacq. 2688.  
*Hasseltia dioica* (Benth.) Sleumer. 2696.  
 Melastomataceæ *Miconia impetolaris* (Sw.) Don. 2690.  
 Symplocaceæ *Symplocos martinicensis* Jacq. *Aguilar* 217.

## SHRUBS:

- Palmæ *Geonoma mexicana* Liebm. *Moxan*, *Cambo*, *Uatapil*. 2691.  
 Piperaceæ *Piper instabilipes* Trel. 2776.  
 Rubiaceæ *Cephaelis tomentosa* (Aubl.) Vahl. 2702.  
*Psychotria chiapensis* Standl. 2654.

## LIANAS AND WOODY SCRAMBLERS:

- Sapindaceæ *Serjania atrolineata* Sauv. & Wright. 2678.  
 Dilleniaceæ *Tetracera volubilis* L. (?). *Sahaak*. 2685.  
 Clusiaceæ *Clusia lundellii* Standl. 3072.  
 Compositæ *Eupatorium* sp. 2775.

## HERBS:

- Polypodiaceæ *Adiantopsis radiata* (L.) Fée. 2716.  
*Adiantum decoratum* Maxon & Weatherby. 2717.  
*Adiantum latifolium* Lam. *Ocpich*. 2703.  
*Adiantum petiolatum* Desv. 2703A.  
*Adiantum pulverulentum* L. 2714, 3892.  
*Dryopteris melanosticta* (Kunze) Kuntze. 2652.  
*Dryopteris oblitterata* (Sw.) C. Chr. 2718, 2753.  
*Pteris altissima* Poir. 2651.  
*Pteris pungens* Willd. 2715.  
 Selaginellaceæ *Selaginella guatemalensis* Baker. 2661, 3883.  
 Gramineæ *Ichnanthus pallens* (Sw.) Munro. 2754.  
*Olyra yucatana* Chase. *Zit*, *Carrizo*. 2682, 2768.  
*Oplismenus hirtellus* (L.) Beauv. 2706.  
 Cyperaceæ *Rynchospora cephalotes* (L.) Vahl. *Navajuello*. 2684.  
 Zingiberaceæ *Costus spicatus* (Jacq.) Sw. *Cooltze*. 2667.

## EPIPHYTES:

- Hymenophyllaceæ *Trichomanes godmani* Hook. 2726.  
 Bromeliaceæ *Billbergia viridiflora* Wendl. 2653.  
*Tillandsia canescens* Sw. 2649.  
 Orchidaceæ *Epidendrum cochleatum* L. 2648.  
*Pleurothallis brighami* S. Wats. 2668.

Piperaceæ	<i>Peperomia pololensis</i> Trel. 2724. <i>Peperomia rotundifolia</i> (L.) HBK. 2728.
Cactaceæ	<i>Rhipsalis coriacea</i> Polak. 2794.

## MILPAS

Along the Subin River in the vicinity of the Santa Teresa rancho, *milpa* clearings are extensive. Plates 4 and 5 give views of those investigated. The *milpa* system, as employed here and elsewhere, has already been described (p. 11).

In a *milpa* which had been planted the previous season, I collected three herbaceous weeds, *Hyptis capitata* (Lundell 2764), *Eupatorium pycnocephalum* (2765), and *Neurolæna lobata* (2774).

## YOUNG SECONDARY FOREST COVERING ABANDONED MILPAS

*Milpa* clearings, abandoned for about six years, were overgrown with secondary forest which averaged about 10 meters in height. Some of the trees were as much as 20 cm. in diameter, but the majority were smaller. The commonest trees in this bush were *Vitex gaumeri*, *Lonchocarpus guatemalensis*, *Bursera simaruba*, *Cecropia* sp., and *Cochlospermum vitifolium*. Others less prominent included *Rinorea hummelii*, *Belotia campbellii*, *Trophis racemosa*, *Zuelania guidonia*, *Nectandra membranacea*, *Lippia myriocephala*, *Croton glabellus*, *Cordia collococca*, *C. glabra*, *C. alliodora*, and *Coccoloba belizensis*. Of the shrubs and treelets, I collected *Ouratea peckii*, *Eugenia capuli*, *Eupatorium morifolium*, and *Psychotria flava*. *Carica papaya* was much in evidence.

Of the lianas and woody scramblers, I obtained determinable material of *Serjania atrolineata*, *Cassia emarginata*, *Vernonia* sp., *Notoptera scabridula*, and *Lasiacis divaricata*. Two large coarse herbs, species of *Heliconia*, were not uncommon. Weedy herbs which characterize the growth in abandoned *milpas* for the first few years had been choked out by the forest vegetation. This *acahual*, approximately six years old, was being felled again for *milpa* in 1933.

The following list includes all the species collected in the secondary bush near the Santa Teresa rancho. The collection numbers are those of the writer.

## TREES:

Moraceæ	<i>Cecropia</i> sp. Guarumo. 2902. <i>Trophis racemosa</i> (L.) Urban. Yaxox, Ramon colorado. 2917.
Polygonaceæ	<i>Coccoloba belizensis</i> Standl. Uva del monte. 2736.
Lauraceæ	<i>Nectandra membranacea</i> Griseb. Zunonte. 2735.
Leguminosæ	<i>Lonchocarpus guatemalensis</i> Benth. Yaxmujin, Palo gusano. 2740.
Burseraceæ	<i>Bursera simaruba</i> (L.) Sarg. Chacah. 2792.
Euphorbiaceæ	<i>Croton glabellus</i> L. 2677, 2779.
Tiliaceæ	<i>Belotia campbellii</i> Sprague. Holol. 2773.
Cochlospermaceæ	<i>Cochlospermum vitifolium</i> (Willd.) Spreng. Cho, Pochote. 2741.
Violaceæ	<i>Rinorea hummelii</i> Sprague. 2770.
Flacourtiaceæ	<i>Zuelania guidonia</i> (Sw.) Britt. & Millsp. Tamay. 2739, 2814.
Boraginaceæ	<i>Cordia alliodora</i> (R. & P.) Cham. Bojon. 2737. <i>Cordia collococca</i> L. 2899. <i>Cordia glabra</i> L. 2743.
Verbenaceæ	<i>Lippia myriocephala</i> Schl. & Cham. Tah. 2780. <i>Vitex gaumeri</i> Greenm. Yaxnic. 2791.

## SHRUBS AND TREELETS:

- Ochnaceæ *Ouratea peckii* Riley. 2742.  
 Myrtaceæ *Eugenia capuli* (Schl. & Cham.) Berg. *Chilimis, Chilonche.* 2813.  
 Rubiaceæ *Psychotria flava* (Erst. 2789.  
 Compositæ *Eupatorium morifolium* Mill. *Chople.* 2815.

## LIANAS AND WOODY SCRAMBLERS:

- Gramineæ *Lasiacis divaricata* (L.) Hitchc. 2734.  
 Leguminosæ *Cassia emarginata* L. 2772.  
 Sapindaceæ *Serjania atrolineata* Sauv. & Wright. 2781.  
 Compositæ *Notoptera scabridula* Blake. 2778.  
*Vernonia* sp. 2777.

## HERBS:

- Musaceæ *Heliconia* sp. *Platanillo.* 2903.  
*Heliconia* sp. *Platanillo.* 2890.  
 Caricaceæ *Carica papaya* L. *Papayo.* 2892.

## ANNOTATED LIST OF THE SPECIES COLLECTED OR OBSERVED IN SOUTHERN PETEN

The list contains 191 species, all the plants known from southern Petén.

## POLYPODIACEÆ

- Adiantopsis radiata* (L.) Fée. Monte Santa Teresa, Subin River, *Lundell* 2716. Occasional small herb, growing in shade of old upland forest.  
*Adiantum decoratum* Maxon & Weatherby. Monte Santa Teresa, Subin River, *Lundell* 2717. Occasional floor plant, growing in shade of old upland forest.  
*Adiantum latifolium* Lam. *Ocpich.* Monte Santa Teresa, Subin River, *Lundell* 2703. Occasional floor plant, growing in shade of old upland forest.  
*Adiantum petiolatum* Desv. Monte Santa Teresa, Subin River, *Lundell* 2703A. Occasional floor plant, growing in shade of old upland forest.  
*Adiantum pulverulentum* L. Monte Santa Teresa, Subin River, *Lundell* 2714, 3892. Occasional floor plant, growing in shade of old upland forest.  
*Asplenium auritum* Sw. Subin River, *Lundell* 2788. Epiphyte on trees along the river.  
*Dryopteris melanosticta* (Kunze) Kuntze. Monte Santa Teresa, Subin River, *Lundell* 2652. Common large floor plant, growing in shade of old upland forest.  
*Dryopteris oblitterata* (Sw.) C. Chr. Monte Santa Teresa, Subin River, *Lundell* 2718, 2753. Occasional floor plant, growing in shade of old upland forest.  
*Nephrolepis pendula* (Raddi) J. Sm. Subin River, *Lundell* 2752, 2758, 2816. Common epiphyte on trees and palms along river.  
*Polypodium costatum* Kunze. Subin River, *Lundell* 2786. Occasional epiphyte on trees along river.  
*Pteris altissima* Poir. Monte Santa Teresa, Subin River, *Lundell* 2651. Occasional floor plant one meter high, growing in shade of old upland forest.  
*Pteris pungens* Willd. Monte Santa Teresa, Subin River, *Lundell* 2715. Occasional floor plant, growing in shade of old upland forest.

## HYMENOPHYLLACEÆ

- Trichomanes godmani* Hook. Monte Santa Teresa, Subin River, *Lundell* 2726. Small epiphyte, growing densely on the thorny base of *Cryosophila argentea*.

## SALVINIACEÆ

- Salvinia rotundifolia* Willd. Subin River, *Lundell* 2756, 3019. Common floating aquatic.

## SELAGINELLACEÆ

- Selaginella guatemalensis* Baker. Monte Santa Teresa, Subin River, *Lundell* 2661, 3883. Common prostrate herb, growing in shade of old upland forest.  
*Selaginella umbrosa* Lem. Rio Pasion, *Aguilar* 431.

## GRAMINEÆ

*Ichnanthus pallens* (Sw.) Munro. Monte Santa Teresa, Subin River, *Lundell 2754*. Common small herb, growing in shade of upland forest.

*Lasiacis divaricata* (L.) Hitchc. Monte Santa Teresa, Subin River, *Lundell 2734*. Common woody scrambler; collected in young secondary upland forest.

*Olyra yucatana* Chase. Zit, Carrizo. Monte Santa Teresa, Subin River, *Lundell 2682, 2768*. Occasional suffrutescent plant of the upland forest.

*Opismenus hirtellus* (L.) Beauv. Monte Santa Teresa, Subin River, *Lundell 2706*. Common forest grass.

*Panicum trichanthum* Nees. Sooc. Subin River, *Lundell 2760*. Very common on wet banks.

## CYPERACEÆ

*Cyperus ochraceus* Vahl. Subin River, *Lundell 2657*. Common sedge on marshy banks.

*Cyperus virens* Michx. Subin River, *Lundell 2658*. Common sedge on marshy banks.

*Eleocharis interstincta* (Vahl) R. & S. Polol. Subin River, *Lundell 2656*. Very common aquatic, growing in shallow water and on marshy banks.

*Hypolytrum nicaraguense* Liebm. Rio Pasion, *Aguilar 496*.

*Rynchospora cephalotes* (L.) Vahl. Navajuillo. Monte Santa Teresa, Subin River, *Lundell 2684*. Common sedge of swampy areas, rare elsewhere.

## PALMÆ

*Bactris* sp. *Jauacte*. Subin River, *Lundell 2655*. Common slender palm 2 to 5 meters high, forming undergrowth thickets on river bank. The species of the genus are viciously spiny.

*Bactris* sp. *Jauacte*. Subin River, *Lundell 2655A*. Common along with the former species in the same habitat.

*Cryosophila argentea* Bartlett. Akuum, Escoba. Monte Santa Teresa, Subin River, *Lundell 2669*. Common thorny palm, growing 3 to 8 meters high in old upland forest. The species characterizes certain swampy habitats.

*Geonoma mexicana* Liebm. Moxan, Cambo, Uatapil. Monte Santa Teresa, Subin River, *Lundell 2691*. Somewhat common palm, growing 2 to 3 meters high in old upland forest.

*Orbignya cohune* (Mart.) Dahlgren. Tutz, Corozo. Subin River. Giant palm, forming immense groves along the river on the higher banks.

*Sabal* sp. *Botan*. Monte Santa Teresa, Subin River. A palm ranging in height from 5 to 15 meters; common in old upland forest.

*Scheelea lundellii* Bartlett. Kantutz, Corozo. Subin River. Giant palm, common along with *Orbignya cohune* in groves on the higher banks of the river.

## BROMELIACEÆ

*Æchmea bracteata* (Sw.) Griseb. Subin River. Common large epiphyte along the river and in the forest.

*Billbergia viridiflora* Wendl. Monte Santa Teresa, Subin River, *Lundell 2653*. An epiphyte along the river and in old upland forest.

*Tillandsia canescens* Sw. Monte Santa Teresa, Subin River, *Lundell 2649*. An epiphyte in old upland forest.

*Tillandsia excelsa* Griseb. Camp 36, British Honduras-Guatemala survey, *Schipp S-815*. "Tall species found as an epiphyte, also growing in peaty soil in swamp forest shade. Common."<sup>1</sup>

*Tillandsia filifolia* Cham. & Schl. Monte Santa Teresa, Subin River, *Lundell 2680*. Occasional small epiphyte along river bank and in the upland forest.

*Tillandsia leiboldiana* Schdl. Camp 34, British Honduras-Guatemala survey, *Schipp S-810*. "Very handsome species common at high altitudes; epiphyte in dense forest shade. Flowers purple, bracts scarlet."

*Tillandsia pruinosa* Sw. Subin River, *Lundell 2900*. Occasional epiphyte on trees along the river.

*Tillandsia valenzuelana* A. Rich. Subin River, *Lundell 2674, 2793*. Common epiphyte on trees along the river.

<sup>1</sup> The quotations are from the labels on the herbarium specimens.

## LEMNACEÆ

*Lemna* sp. Subin River, *Lundell* 3020. Common floating aquatic.

## ARACEÆ

*Anthurium scandens* (Aubl.) Engl. (?). Subin River, *Lundell* 2671. Rare small root-climbing epiphyte on trees along the river.

*Anthurium tetragonum* Hook. var. *yucatanense* Engl. Subin River, *Lundell* 2708, 2889. Very common giant epiphyte on large branches overhanging the river.

*Philodendron smithii* Engl. Subin River, *Lundell* 2888. Common epiphyte on trees along the river.

*Pistia stratiotes* L. *Xicinchah*, *Lechuga*. Subin River, *Lundell* 2666. Very common floating aquatic.

## PONTEDERIACEÆ

*Eichhornia crassipes* (Mart.) Solms. *Ninfa*. Subin River, *Lundell* 2665. Floating aquatic which dominates the stream completely blocking water transportation when not removed.

*Pontederia lanceolata* Nutt. Subin River, *Lundell* 2709. Commonly occurring in shallow water along the bank.

## MUSACEÆ

*Heliconia* sp. *Platanillo*. Monte Santa Teresa, Subin River, *Lundell* 2903. Coarse herb; collected in young secondary upland forest.

*Heliconia* sp. *Platanillo*. Monte Santa Teresa, Subin River, *Lundell* 2890. Coarse herb; collected in young secondary upland forest.

## ZINGIBERACEÆ

*Costus spicatus* (Jacq.) Sw. *Cooltze*. Monte Santa Teresa, Subin River, *Lundell* 2667. Coarse herb; encountered occasionally in upland forest.

## ORCHIDACEÆ

*Camaridium pulchrum* Schltr. Monte Santa Teresa, Subin River, *Lundell* 2978. Occasional epiphyte on trees along the river.

*Epidendrum cochleatum* L. Monte Santa Teresa, Subin River, *Lundell* 2648. Common epiphyte in the forest.

*Epidendrum imatophyllum* Lindl. Subin River, *Lundell* 2670. Occasional epiphyte on trees along the river.

*Oncidium pusillum* (L.) Rehb. f. Rio Pasion, *Aguilar* 519.

*Pleurothallis brighami* S. Wats. Monte Santa Teresa, Subin River, *Lundell* 2668. Uncommon small epiphyte in old upland forest.

## PIPERACEÆ

*Peperomia pololensis* Trel. Monte Santa Teresa, Subin River, *Lundell* 2724. Common small epiphyte of older forest.

*Peperomia rotundifolia* (L.) HBK. Monte Santa Teresa, Subin River, *Lundell* 2728. Small scandent epiphyte of older forest; encountered only once.

*Piper instabilipes* Trel. Monte Santa Teresa, Subin River, *Lundell* 2776, type collection. A shrub of old upland forest; apparently quite common.

## FAGACEÆ

*Quercus acutifolia* Née. Camp 36, British Honduras-Guatemala survey, *Schipp* 1249. "Medium-sized tree of erect habit growing in swampy forest. Rare."

*Quercus insignis* Mart. & Gal. Camp 36, British Honduras-Guatemala survey, *Schipp* 1247. "One of the giant trees of the locality. Occasional."

*Quercus schippii* Standl. Camp 36, British Honduras-Guatemala survey, *Schipp* 1248. "Another giant like the preceding number and growing in the same locality in hill forest at altitude of about 900 meters. Tree about 32 meters high, somewhat more than 1 meter in diameter. Occasional."

## MORACEÆ

*Cecropia mexicana* Hemsl. *Guarumo*. Monte Santa Teresa, Subin River, *Lundell 2891*. Common tree as much as 25 meters in height and 45 cm. in diameter; found generally in old upland forest.

*Cecropia* sp. *Guarumo*. Monte Santa Teresa, Subin River, *Lundell 2902*. Very common small, slender tree; often dominant in young secondary upland forest covering abandoned *milpas*.

*Piratinera panamensis* Pittier. Camp 36, British Honduras-Guatemala survey, *Schipp 1246*. "Small tree in damp forest shade. Rare."

*Pseudolmedia spuria* (Sw.) Griseb. Camp 34, British Honduras-Guatemala survey, *Schipp 1271*. "Medium-sized tree common inland in limestone formation. Flowers cream colored, fruits red, edible, and of fine flavor. Known locally as 'wild cherry.'"

*Trophis racemosa* (L.) Urban. *Yaxox, Ramon colorado*. Monte Santa Teresa, Subin River, *Lundell 2917*. A tree 8 to 15 meters high in young secondary upland forest; not very common. The leaves are good for forage.

## OLACACEÆ

*Heisteria chippiana* Standl. Camp 34, British Honduras-Guatemala survey, *Schipp 1286*. "Medium-sized tree with large spreading crown, growing in calcareous soil. Occasional."

## POLYGONACEÆ

*Coccoloba belizensis* Standl. *Uva del monte*. Monte Santa Teresa, Subin River, *Lundell 2736*. Very slender tree 5 to 8 meters high, growing in young secondary upland forest. The species is characterized by exceedingly large leaves; not common in Petén.

## NYMPHÆACEÆ

*Cabomba aquatica* Aubl. *Uchul*. Subin River, *Lundell 2755*. Common aquatic, growing submerged in large patches.

*Nymphæa ampla* (Salisb.) DC. *Nohoch naab, Nape*. Subin River, *Lundell 2759*. Very common aquatic with large floating leaves and attractive white flowers.

## ANNONACEÆ

*Cymbopetalum penduliflorum* (Dun.) Baill. Monte Santa Teresa, Subin River, *Lundell 2950*. Small slender tree about 8 meters high; collected in old upland forest. Apparently not common in the area.

## LAURACEÆ

*Misanteca capitata* Cham. & Schl. (?). Camp 31, British Honduras-Guatemala survey, *Schipp 1282*. "Small tree in shady valley, also on hill top in open place. Occasional."

*Nectandra membranacea* Griseb. (?). *Zunonte*. Monte Santa Teresa, Subin River, *Lundell 2735*. Collected in young secondary upland forest. It does not appear to be common.

The specific names assigned to the species of Lauraceæ are only tentative.

*Nectandra sanguinea* Rottb. (?). Camp 31, British Honduras-Guatemala survey, *Schipp 1262*. "Small tree-like shrub, quite common in the interior at high altitudes."

## ROSACEÆ

*Photinia microcarpa* Standl. Camp 32, British Honduras-Guatemala survey, *Schipp 1291*; Camp 35, British Honduras-Guatemala survey, *Schipp 1312*. "Medium-sized tree seen occasionally in the hills in partial shade. Occasional."

## LEGUMINOSÆ

*Acacia glomerosa* Benth. (?). *Cantemoc*. Monte Santa Teresa, Subin River, *Lundell 2812*. Slender tree approximately 40 meters in height. Apparently rare as I encountered it only once in old upland forest.

*Acacia mayana* Lundell. *Cruzetillo*. San Diego, Rio Pasion, *Aguilar 495*, type collection.

*Cassia emarginata* L. Monte Santa Teresa, Subin River, *Lundell 2772*. A clambering liana in the young secondary upland forest.

*Desmodium intortum* (Mill.) Urban. Camp 31, British Honduras-Guatemala survey, Schipp 1285. "Small woody vine growing in dense shade on hillsides. It seems to be a very rare plant."

*Dialium guianense* (Aubl.) Steud. *Chate*. Monte Santa Teresa, Subin River, Lundell 2687. Common tree of old upland forest, reaching a height of 40 meters and a diameter of 60 to 90 centimeters. This is one of the dominant species in the Santa Teresa forest.

*Inga edulis* Mart. *Uatop, Bitze*. Subin River, Lundell 2676. Very common tree of the river bank; it scarcely ever exceeds 10 meters in height.

*Inga schippii* Standl. Camp 31, British Honduras-Guatemala survey, Schipp 1283. "Very handsome tree when in flower, growing in shaded valley in calcareous soil. Rare."

*Lonchocarpus guatemalensis* Benth. *Yaxmujin, Palo gusano*. Monte Santa Teresa, Subin River, Lundell 2740. Common tree in the young secondary upland forest; about 8 meters in height.

*Pithecolobium lanceolatum* (H. & B.) Benth. Santa Teresa, Subin River, Aguilar 527.

*Vigna repens* (L.) Kuntze. Subin River, Lundell 2660. Slender herbaceous vine, growing so densely over the river bank trees that it forms virtually a green blanket. Plate 39.

## RUTACEÆ

*Esenbeckia pentaphylla* (Macfad.) Griseb. Camp 32, British Honduras-Guatemala survey, Schipp S-643. "Large tree with round straight bole growing in shady valleys. Rare."

## MELIACEÆ

*Swietenia macrophylla* King. *Caoba*. Monte Santa Teresa, Subin River. A giant tree of old upland forest, sometimes reaching a height of 60 meters and a diameter of almost 3 meters. Only comparatively small trees remain in the culled Santa Teresa forest.

*Trichilia moschata* Sw. Camp 31, British Honduras-Guatemala survey, Schipp 1284. "Very common small tree growing on hills and in valleys at high altitudes."

## BURSERACEÆ

*Bursera simaruba* (L.) Sarg. *Chacah*. Monte Santa Teresa, Subin River, Lundell 2792. Very common tree in the young secondary upland forest.

## POLYGALACEÆ

*Polygala jamaicensis* Chodat. Camp 36, British Honduras-Guatemala survey, Schipp 1254. "Small shrub growing in swampy places in shade. I have seen only a single plant."

## EUPHORBIACEÆ

*Acalypha diversifolia* Jacq. (?). Camp 34, British Honduras-Guatemala survey, Schipp 1290. "Medium-sized shrub found on hill top in partial shade."

*Adelia barbinervis* Schl. & Cham. Rio Pasion, Aguilar 515.

*Croton glabellus* L. Monte Santa Teresa, Subin River, Lundell 2677, 2779. Common small tree in young secondary upland forest.

*Drypetes* sp. Camp 35, British Honduras-Guatemala survey, Schipp 1251, 1252. "Medium-sized tree growing on hillside in forest shade."

*Hieronyma alchorneoides* Allem. Camp 35, British Honduras-Guatemala survey, Schipp 1311. "Tall erect tree with small compact crown growing in forest shade at high altitudes."

*Pera barbellata* Standl. Monte Santa Teresa, Subin River, Lundell 2686. A medium-sized tree of old upland forest; apparently rare.

## CELASTRACEÆ

*Maytenus longipes* Briq. Camp 35, British Honduras-Guatemala survey, Schipp S-635. "Small shrub growing in swampy forest shade."

*Rhacoma eucymosa* (Loes. & Pitt.) Standl. Rio Pasion, Aguilar 432.

## SAPINDACEÆ

*Serjania atrolineata* Sauv. & Wright. Monte Santa Teresa, Subin River, Lundell 2678, 2781. Common liana of young and old upland forest.



## TILIACEÆ

*Belotia campbellii* Sprague. *Holol.* Monte Santa Teresa, Subin River, *Lundell 2773*. Occasional tree in young secondary upland forest; about 10 meters high.

*Sloanea schippii* Standl. Camp 36, British Honduras-Guatemala survey, *Schipp 1245*. "Medium-sized tree quite rare in the locality."

## BOMBACACEÆ

*Bombax ellipticum* HBK. *Chulte.* Monte Santa Teresa, Subin River, *Lundell 2681*; Camp 32, British Honduras-Guatemala survey, *Schipp 1280*. Widely distributed giant of old upland forest. It reaches a height of 35 meters and a diameter exceeding 1 meter.

*Hampea tomentosa* (Presl.) Standl. Rio Pasion, *Aguilar 518*.

*Pachira aquatica* Aubl. *Uacoot, Zapotobobo.* Subin River, *Lundell 2664*. Common river bank tree about 10 meters in height.

## DILLENIACEÆ

*Tetracera volubilis* L. (?). *Sahaak.* Monte Santa Teresa, Subin River, *Lundell 2685*. Large tree-top liana of old upland forest.

## OCHNACEÆ

*Ouratea peckii* Riley. Monte Santa Teresa, Subin River, *Lundell 2719, 2742*. Shrub or small slender tree; encountered occasionally in young and old upland forest.

*Ouratea pyramidalis* Riley. Camp 33, British Honduras-Guatemala survey, *Schipp 1239*. "Very handsome tree of upright habit; found only in moist shady forest. Common."

## MARCGRAVIACEÆ

*Marcgravia schippii* Standl. Camp 32, British Honduras-Guatemala survey, *Schipp 1273*. "Giant vine seen only at high altitudes in forest shade. Rare."

## CLUSIACEÆ

*Calophyllum brasiliense* Camb. var. *rekoii* Standl. Monte Santa Teresa, Subin River, *Lundell 2771*. A giant of old upland forest reaching a height of 35 meters and a diameter of about 1 meter.

*Clusia belizensis* Standl. Camp 33, British Honduras-Guatemala survey, *Schipp 1242*, type collection. "Small tree growing on hill top in forest shade. Rare."

*Clusia lundellii* Standl. Monte Santa Teresa, Subin River, *Lundell 3072*, type collection. A giant liana ascending to the top of the highest trees in old upland forest and reaching a diameter of 20 cm. Apparently rare, as it was encountered only once.

*Clusia rosea* Jacq. Camp 34, British Honduras-Guatemala survey, *Schipp 1288*. "The largest of all trees in the genus, growing on hill tops in open places. Common."

*Clusia salvinii* Donn. Sm. Camp 32, British Honduras-Guatemala survey, *Schipp 1275*. "Tree-like epiphyte found at high altitudes. Rare."

## TURNERACEÆ

*Erblichia odorata* Seem. Rio Pasion, *Aguilar 500*.

## COCHLOSPERMACEÆ

*Cochlospermum vitifolium* (Willd.) Spreng. *Cho, Pochote.* Monte Santa Teresa, Subin River, *Lundell 2741*. Very common small slender tree in young secondary upland forest.

## VIOLACEÆ

*Hybanthus malpighiifolius* Standl. Camp 32, British Honduras-Guatemala survey, *Schipp 1278*, type collection. "Medium-sized tree, quite common at high altitudes. Called 'white pine.'"

*Rinorea hummelii* Sprague. Monte Santa Teresa, Subin River, *Lundell* 2683, 2763, 2770. A small tree; collected in both young and old upland forest; not common.

## FLACOURTIACEÆ

*Casearia nitida* (L.) Jacq. Monte Santa Teresa, Subin River, *Lundell* 2688. Uncommon small tree in old upland forest.

*Hasseltia dioica* (Benth.) Sleumer. Monte Santa Teresa, Subin River, *Lundell* 2696. Small slender tree in old upland forest.

*Homalium hondurensis* Blake. Monte Santa Teresa, Subin River, *Lundell* 2663. A tree 10 meters high, growing on the river bank; not common.

*Zuelania guidonia* (Sw.) Britt. & Millsp. *Tamay*. Monte Santa Teresa, Subin River, *Lundell* 2739, 2814. Common tree in young secondary upland forest.

## CARICACEÆ

*Carica papaya* L. Monte Santa Teresa, Subin River, *Lundell* 2892. Common erect tree-like plant reaching a height of 5 meters; characteristic in young secondary upland forest covering abandoned milpas.

## CACTACEÆ

*Epiphyllum crenatum* (How.) Don. *Pitaya*. Subin River, *Lundell* 2901. Epiphyte on tree overhanging river.

*Rhipsalis coriacea* Polak. Monte Santa Teresa, Subin River, *Lundell* 2794. Woody epiphyte on tree in old upland forest; apparently rare.

## LYTHRACEÆ

*Cuphea axilliflora* Koehne. Camp 35, British Honduras-Guatemala survey, *Schipp* S-634. "Very pretty herb growing in swampy places in shade. Rare."

## COMBRETACEÆ

*Bucida buceras* L. Subin River, *Lundell* 2785. Very common tree on the river bank; it is a giant reaching a height of 25 meters and a diameter near 1 meter.

*Combretum mexicanum* Humb. & Bonpl. Subin River, *Lundell* 2675. Uncommon large vine on river bank.

## MYRTACEÆ

*Calyptanthus megistophylla* Standl. Camp 32, British Honduras-Guatemala survey, *Schipp* 1265, type collection. "Large tree growing in dense shady valleys at high altitudes. Rare."

*Calyptanthus millspaughii* Urban. Rio Pasion, *Aguilar* 526.

*Eugenia bumelioides* Standl. Camp 32, British Honduras-Guatemala survey, *Schipp* 1270, type collection. "Small tree on hill top in dense shade. Rare."

*Eugenia capuli* (Schl. & Cham.) Berg. *Chilonche*, *Chilimis*. Monte Santa Teresa, Subin River, *Lundell* 2813. Common small slender tree or shrub in young secondary upland forest.

*Eugenia fragrans* (Sw.) Willd. Camp 33, British Honduras-Guatemala survey, *Schipp* 1240. "Small compact tree of medium height which seems to be common at high altitudes."

*Eugenia* sp. Camp 23, British Honduras-Guatemala survey, *Schipp* S-644. "Medium-sized tree growing on creek bank in forest shade. Rare."

## MELASTOMATACEÆ

*Blakea cuneata* Standl. Camp 32, British Honduras-Guatemala survey, *Schipp* 1237. "Small tree generally growing as an epiphyte in forest shade. Common."

*Miconia ciliata* (L. Rich.) DC. (?). Camp 36, British Honduras-Guatemala survey, *Schipp* 1244. "Small tree growing in forest shade. Rare."

*Miconia lacera* (Bonpl.) Naud. Monte Santa Teresa, Subin River, *Lundell* 2766. Shrub 2 meters high in old upland forest.

*Miconia impetiolaris* (Sw.) Don. Monte Santa Teresa, Subin River, *Lundell* 2690. Small slender tree, growing in shade of old upland forest; not common.

## UMBELLIFERÆ

*Hydrocotyle umbellata* L. *Naab mejen*. Subin River, *Lundell* 2757. Aquatic with floating leaves, growing in shallow water along the bank; not common.

## ARALIACEÆ

*Oreopanax guatemalense* (Lem.) Dene. & Planch. Monte Santa Teresa, Subin River, *Lundell* 2906. A tree of old upland forest.

*Oreopanax lachnocephala* Standl. Camp 31, British Honduras-Guatemala survey, *Schipp* 1272, type collection. "Tall handsome tree growing on limestone hills at high altitudes. Common."

## EBENACEÆ

*Diospyros schippii* Standl. Camp 34, British Honduras-Guatemala survey, *Schipp* 1281, type collection. "Large tree with a rather compact crown, growing on hillside. Rare."

## SYMPLOCACEÆ

*Symplocos martinicensis* Jacq. Monte Santa Teresa, Subin River, *Aguilar* 217; Camp 32, British Honduras-Guatemala survey, *Schipp* 1268. "Small tree growing on hillside in dense shade. Very rare in the locality."

## SAPOTACEÆ

*Achras chicle* Pittier. Camp 32, British Honduras-Guatemala survey, *Schipp* 1264. "One of the largest trees in the colony and the commonest at high altitudes. It reaches a height of 35 meters and a diameter of 1 meter."

*Achras zapota* L. Camp 33, British Honduras-Guatemala survey, *Schipp* 1310. "Common tree throughout colony; it seems to prefer calcareous soil."

*Lucuma belizensis* Standl. Camp 32, British Honduras-Guatemala survey, *Schipp* 1269. "A large tree with a rather dense compact crown; quite common inland in hill forest growth."

*Sideroxylon amygdalinum* Standl. Camp 34, British Honduras-Guatemala survey, *Schipp* 1289. "Tall slender tree with very small crown of compact habit, growing in forest."

*Sideroxylon lundellii* Standl. *Lechillo*. Monte Santa Teresa, Subin River, *Lundell* 2767, type collection. A tree 35 meters high and 1 meter in diameter with a somewhat asymmetrical trunk; encountered once in old upland forest.

*Sideroxylon meyeri* Standl. Camp 33, British Honduras-Guatemala survey, *Schipp* 1238; Camp 32, British Honduras-Guatemala survey, *Schipp* 1287. "Medium-sized tree with dense compact crown, growing on hill top in forest shade in calcareous soil. Occasional."

## OLEACEÆ

*Linociera domingensis* (Lam.) Krug & Urb. Camp 32, British Honduras-Guatemala survey, *Schipp* 1301. "Large tree with spreading crown growing at high altitudes. Occasional."

*Linociera oblanceolata* Robinson. Monte Santa Teresa, Subin River, *Lundell* 2692. A tree 20 meters high; in old upland forest; encountered only once.

## CONVOLVULACEÆ

*Merremia umbellata* (L.) Hallier. Rio Pasion, *Aguilar* 512.

## BORAGINACEÆ

*Cordia alliodora* (R. & P.) Cham. *Bojon*. Monte Santa Teresa, Subin River, *Lundell* 2737. A tree 10 meters high in young secondary upland forest.

*Cordia collococca* L. Monte Santa Teresa, Subin River, *Lundell* 2899. A tree 12 meters high in young secondary upland forest.

*Cordia glabra* L. Monte Santa Teresa, Subin River, *Lundell* 2743. Common tree from 8 to 12 meters in height in young secondary upland forest.

*Tournefortia hirsutissima* L. Rio Pasion, *Aguilar* 508.

## VERBENACEÆ

*Clerodendron ligustrinum* (Jacq.) R. Br. *Muste*. Rio Pasion, *Aguilar* 433.

*Lippia myriocephala* Schl. & Cham. *Tah*. Monte Santa Teresa, Subin River, *Lundell* 2780. Common small tree in young secondary upland forest.

*Lippia reptans* HBK. Rio Pasion, *Aguilar* 434.

*Vitex gaumeri* Greenm. *Yaxnic*. Monte Santa Teresa, Subin River, *Lundell* 2662, 2791. Very common tree in young and old upland forest.

## LABIATÆ

*Hyptis capitata* Jacq. Monte Santa Teresa, Subin River, *Lundell* 2764. Weedy herb, growing in an abandoned *milpa*.

*Salvia* sp. Camp 32, British Honduras-Guatemala survey, *Schipp* S-632. "Tall slender shrub, very handsome when in flower. Occasional."

## SOLANACEÆ

*Solanum salviifolium* Lam. Camp 34, British Honduras-Guatemala survey, *Schipp* S-677. "Small tree-like shrub growing in dense, damp, shady forest. Rare in the mountains."

## BIGNONIACEÆ

*Petastoma ocositense* (Donn. Sm.) Kranzl. Subin River, *Lundell* 2659. Liana, growing at edge of river.

*Tynnanthus hyacinthinus* Standl. Camp 33, British Honduras-Guatemala survey, *Schipp* 1241. "Tall woody vine growing in forest on *Achras*. Rare."

## ACANTHACEÆ

*Justicia breviflora* (Nees) Rusby. Rio Pasion, *Aguilar* 516.

*Justicia comata* (L.) Lam. Santa Teresa, Subin River, *Lundell* 2761. Small slender herb, growing commonly in patches on low saturated river bank.

*Odontonema albiflorum* Leonard. Rio Pasion, *Aguilar* 510.

## RUBIACEÆ

*Cephaelis tomentosa* (Aubl.) Vahl. Monte Santa Teresa, Subin River, *Lundell* 2702. Common low shrub, growing in the shade of old upland forest.

*Faramea belizensis* Standl. Camp 36, British Honduras-Guatemala survey, *Schipp* S-721, type collection. "Handsome small tree growing on mountain side in forest shade. Rare."

*Guettarda macrosperma* Donn. Sm. Camp 35, British Honduras-Guatemala survey, *Schipp* S-633. "Medium-sized tree in forest shade on hillside. Occasional."

*Hamelia axillaris* Sw. Camp 32, British Honduras-Guatemala survey, *Schipp* 1250. "Small slender tree seen only in dense forest shade on hill slopes."

*Hillia tetrandra* Sw. Camp 34, British Honduras-Guatemala survey, *Schipp* S-585. "Medium-sized shrub growing in forest shade."

*Palicourea galeottiana* Martens. (?). Camp 32, British Honduras-Guatemala survey, *Schipp* 1274. "Very handsome small tree growing on limestone hill in forest shade. Occasional."

*Psychotria chiapensis* Standl. Monte Santa Teresa, Subin River, *Lundell* 2654. Low shrub, growing in shade of old upland forest.

*Psychotria cuspidata* Bredem. Rio Pasion, *Aguilar* 506.

*Psychotria flava* Griseb. Monte Santa Teresa, Subin River, *Lundell* 2789. Low shrub, growing in young secondary upland forest.

*Psychotria fruticetorum* Standl. Rio Pasion, *Aguilar* 499.

*Psychotria marginata* Sw. Rio Pasion, *Aguilar* 509.

*Psychotria pleuropoda* Donn. Sm. Camp 32, British Honduras-Guatemala survey, *Schipp* S-637. "Small shrub growing in swampy places in dense forest shade."

## COMPOSITÆ

*Baccharis trinervis rhexioides* (HBK.) Baker. Rio Pasion, *Aguilar* 505.

*Eupatorium* sp. Monte Santa Teresa, Subin River, *Lundell* 2775. A woody scrambler; collected in old upland forest.

*Eupatorium morifolium* Mill. *Chople*. Monte Santa Teresa, Subin River, *Lundell 2815*. Occasional shrub in young secondary upland forest.

*Eupatorium pycnocephalum* Less. Monte Santa Teresa, Subin River, *Lundell 2765*. An herb, growing in an abandoned *milpa*.

*Harleya oxylepis* (Benth.) Blake. Subin River, *Lundell 2672*. Occasional subscandent herb, growing in saturated soils on low river bank.

*Liabum polyanthum* Klatt. (?). Rio Pasion, *Aguilar 517*.

*Neurolæna lobata* (L.) R. Br. Monte Santa Teresa, Subin River, *Lundell 2774*. Large coarse herb, growing in an abandoned *milpa*.

*Notoptera scabridula* Blake. Monte Santa Teresa, Subin River, *Lundell 2778*. A woody vine; in young secondary upland forest.

*Vernonia* sp. Monte Santa Teresa, Subin River, *Lundell 2777*. A woody scrambler; in young secondary upland forest.

## RELATIONSHIPS OF THE PETÉN FLORA

The known flora of the Department of Petén totals about 1400 species, including cultivated and introduced plants. A total of approximately 785 species were collected or noted in Northern Petén, 835 species in the Central Petén Savanna Country, and 191 in the borderlands of southern Petén. In the collections from the Department, 31 per cent of the species are restricted to Northern Petén, 35 per cent to the Central Petén Savanna Country, and 6 per cent to southern Petén. The remaining 28 per cent of the species are represented in at least two of the three sections. The greater part of Northern Petén is covered with climax and edaphic climax forest, while the Central Petén Savanna Country consists primarily of grasslands and secondary forest; hence it is not surprising to find such a wide difference in their floras. Further exploration will undoubtedly reduce this, yet the number will always remain high as long as present conditions persist in the two phytogeographical divisions.

The forest of Northern Petén is a continuation of the forest of Campeche and northern British Honduras, with local variations due to higher rainfall and topographical differences. Although more luxuriant than the broad-leaved forest of Southwestern Campeche (*Lundell, 1934b*), southeastern Campeche (formerly part of Quintana Roo), and northern British Honduras, the forest of Northern Petén is not markedly different in general aspects. The vegetation does not have the luxuriance of true rain-forest, hence it may be designated as quasi-rain-forest. The rainfall averages less than 1,800 mm., a maximum not sufficient to maintain true rain-forest in a region with a pronounced dry season. Although the majority of the trees are evergreen, enough are deciduous so that the quasi-rain-forest must be considered semi-deciduous. In years when the dry season is prolonged and severe, the deciduous nature of the vegetation is pronounced, in other years it is not outstanding.

The greater part of the Northern Petén climax forest covers land which was once cleared for agriculture. Although enough time has elapsed since abandonment to allow the upland vegetation to reach the climax stage, yet there is a comparative scarcity of such true climax rain-forest types as palms. It is probable that the only original forest in the region is to be encountered on precipitous hill

caps and in wooded swamps. Even here timber and firewood were probably removed by the ancient Maya. It is on the hills and in the swamps that most endemic species are found, which indicates these areas were least disturbed.

In the Central Petén Savanna Country, the vegetation on the limestone hills and in the limestone valleys is closely related to that of Northern Petén, yet it is largely secondary. The grasslands and flatland forest show the least relationship to Northern Petén, as one would naturally expect. The grassland flora is closely allied to that of the pinelands of northern British Honduras and other similar areas throughout Central America.

Southern Petén is so little known botanically that little can be said concerning its vegetation.

Of the 1400 species herein recorded as occurring in Petén, about 760 have not been reported from the states of Yucatan and Campeche (including Quintana Roo), the area covered by Standley's *Flora of Yucatan* and the writer's *Preliminary sketch of the phytogeography of the Yucatan Peninsula*.

The forests of Campeche and eastern Yucatan are still very little known, which undoubtedly accounts for the startling difference. On the other hand, most of the plants known from Petén occur in British Honduras. The flora of the Yucatan Peninsula, south to the Sibun River in British Honduras and central Petén, now totals more than 2000 species and future explorations will probably increase it to around 3000.

The humid lowland life zone of tropical America extends from Veracruz on the north to the Amazon valley in South America and includes the West Indies. The lowland flora of this vast area is closely related as to families and genera, as well as species. The zone may be subdivided, however, into major phytogeographical units, each with its floristic and physiographical peculiarities. The Yucatan Peninsula is one of these major units, having a flora with about 15 per cent of endemic species.

Within the Yucatan Peninsula, local variations in flora, climate, topography, edaphic conditions, and the degree to which the vegetation has been subjected to destructive influences of man make it possible to recognize minor phytogeographical divisions such as I have tentatively outlined (Lundell, 1934b, fig. 1).

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## APPENDIX<sup>1</sup>

### STUDIES OF MEXICAN AND CENTRAL AMERICAN PLANTS—I

As a result of the 1931, 1932, 1933, and 1936 expeditions of the Carnegie Institution of Washington and the University of Michigan to the Yucatan Peninsula, the Herbarium of the University of Michigan has added approximately 8000 specimens to its collection. From the earlier collections of Deam, Gaumer, Valdez, and the writer, and the recent collections of Schipp, Gentle, Chanek, Aguilar, and Skutch, about 8000 other specimens are deposited in the herbarium, making a total of almost 16,000 specimens of ferns and flowering plants from the Maya area. Even though much material is available, the need for additional botanical exploration, even in the well-known sections of the State of Yucatan, can not be over-emphasized.

Through the kind cooperation of taxonomists specializing in the study of certain families, a start has been made toward a comprehensive treatment of the flora. It is to be hoped that the monographic studies can be carried forward until all the important families have been covered.

The present paper, based primarily on the collections in the Herbarium of the University of Michigan, is the first of a series to be devoted mainly to plants of the Maya area.

#### PIPERACEÆ

**Piper sempervirens** (Trel.) Lundell, comb. nov.

*Arctotonia sempervirens* Trel., Field Mus. Nat. Hist., Bot. 12 : 405. 1936.

**Piper tuxpeñyana** (Trel.) Lundell, comb. nov.

*Arctotonia tuxpeñyana* Trel., Field Mus. Nat. Hist., Bot. 12 : 406. 1936.

#### MORACEÆ

**Piratinera terrabana** (Pittier) Lundell, comb. nov.

*Brosimum terrabanum* Pittier, Contr. U. S. Nat. Herb. 18 : 69. 1914.

#### SPECIMENS EXAMINED:

British Honduras. Belize District: Gracie Rock on the Sibun River, *Gentle 1737*; vernacular names "*macica bravo*," "*ramon macho*." Stann Creek District: Maya Mounds in vicinity of the Cockscomb Mountains, *Schipp 522*.

An examination of material from the recent collections in British Honduras shows that the species should be referred to *Piratinera*. Each receptacle has 2 or more female flowers, and the fruits are 1- to 5-seeded. In *Brosimum* each receptacle has only 1 female flower, and the fruits are 1-seeded.

#### NYCTAGINACEÆ

**Torrubia petenensis** Lundell, sp. nov.

Arbor parva 5 m. alta; ramulis gracilibus, albidis, novellis tomentosis; petiolis gracilibus 10–23 mm. longis; laminis anguste obovatis vel ellipticis, 7–9.5 cm. longis, 2.5–4.5 cm. latis, apice basique

<sup>1</sup> Issued June 16, 1937.

acutiusculis, subtus dense molliter fulvo-pubescentibus, supra sparsius pubescentibus et siccitate atro-discoloribus; inflorescentia terminali, paniculata, multiflora; pedunculis 4–8 cm. longis, breviter pilosis, siccitate discoloribus; pedicellis 1.5–2.5 mm. longis; floribus ut videtur perfectis, bracteolis 1–3 lanceolatis puberulis subtentis; perianthio tubuloso-campanulato, 4–5 mm. longo, dense glanduloso-puberulo, limbo induplicato-valvato, obscure 5-lobato, lobis rotundatis; staminibus 8; filamentis gracilibus, exsertis, 5.5–9 mm. longis, inæqualibus, basi breviter connatis; antheris parvis, 2-cellulis; pistilo 1 (raro 2); ovario oblongo, ca. 1.2 mm. longo, 1-cellulo; stylo gracili, 2.1–2.5 mm. longo; stigmatibus papilloso, nec penicillato nec more *Pisoniellæ* capitato.

A small tree 5 meters high; branchlets slender, tomentose; petioles slender, 10 to 23 mm. long; leaf blades narrowly obovate or elliptic, 7 to 9.5 cm. long, 2.5 to 4.5 cm. wide, apex and base acutish, densely soft fulvous-pubescent beneath, less hairy above, drying brownish-black; inflorescence of large, terminal, many-flowered panicles; peduncles 4 to 8 cm. long, short-hairy, drying brownish-black; pedicels 1.5 to 2.5 mm. long; flowers apparently perfect, subtended by 1 to 3 lanceolate, puberulent bracts; perianth tubular-campanulate, 4 to 5 mm. long, glandular-puberulent, the limb induplicate-valvate, shallowly 5-lobed, the lobes rounded; stamens 8; filaments slender, exserted, 5.5 to 9 mm. long, unequal, short-connate at base; anthers small, 2-celled; pistils 1, rarely 2; ovary oblong, about 1.2 mm. long, 1-celled; style slender, 2.1 to 2.5 mm. long; stigma papillose; fruit unknown.

Type in the Herbarium of the University of Michigan, *C. L. Lundell 3518*, collected in forest on top of a limestone hill at La Libertad, Department of Petén, Guatemala, May 31, 1933.

The generic position of the species is uncertain.

#### BERBERIDACEÆ

##### *Mahonia pinifolia* Lundell, sp. nov.

Frutex glaber, 3 m. altus, luteo-ligneus; ramulis brevibus, crassis; foliis plerumque in apice ramulorum confertis, coriaceis, trifoliolatis vel 5-foliolatis, breviter petiolatis; petiolis pallide rubris, 1–5.5 mm. longis, basi sensim expansis et subvaginantibus; foliolis sessilibus, digitatis, revolutis, rigidis, aciculiformibus, 1.2 mm. latis, 1.5–3 cm. longis, integris vel dentatis vel paucilobatis, apice spinula terminatis; infructescentia terminali ex racemis paucis, brevibus, paucibaccatis constante; pedicellis gracilibus, 3–5 mm. longis, pallide rubris; baccis atro-rubris, globosis, 5–8 mm. diametro; seminibus 5–9, reniformibus vel obovoideis, 3.5–4 mm. longis, 1.2–2 mm. latis, rubris.

A glabrous shrub, 3 meters high, with yellow wood; branchlets short, thick; leaves mostly crowded at the ends of the short branchlets, coriaceous, 3- to 5-foliolate, short-petiolate; the petioles 1 to 5.5 mm. long, broadened and slightly clasping at base, light red in color; leaflets sessile, digitate, revolute, reduced and needle-like, about 1.2 mm. wide, 1.5 to 3 cm. long, entire, toothed, or 1- to few-lobed, rigid, spine-tipped; infructescence terminal, the few fruits borne on short racemes; pedicels slender, 3 to 5 mm. long, reddish; berries red, globose, 5 to 8 mm. in diameter, 5- to 9-seeded; the seed kidney-shaped or obovoid, 3.5 to 4 mm. long, 1.2 to 2 mm. wide, rufous.

Type in the Herbarium of the University of Michigan, *C. L. Lundell 5608*, collected in a shallow alkaline basin on the road between Charcas and Santo Domingo, San Luis Potosi, Mexico, August 7, 1934.

The sessile, revolute, needle-like leaflets of *M. pinifolia* distinguish the species from all others in the genus.

#### LAURACEÆ

##### *Misanteca campechiana* (Standl.) Lundell, comb. nov.

*Ocotea campechiana* Standl., Carnegie Inst. Wash. Pub. No. 461 : 56. 1935.

##### SPECIMENS EXAMINED:

Mexico. Campeche: Tuxpeña, *Lundell 1295*, type collection; 1380.

Guatemala. Department of Petén: La Libertad, *Lundell 3065, 3359, 3409*; Uaxactun, *Bartlett 12339*.

## LEGUMINOSÆ

*Acacia mayana* Lundell, sp. nov.

Frutex vel arbor parva, ramulis glabris, nitidis; spinis stipularibus atropurpureis, magnis, 4–7 cm. longis, 1–1.8 cm. latis, deorsum subcompressis lateribus late acuteque alatis, apice rigidis acutissimis, intus in domiculis formicarum cum intrusione magna stipitata capitata oriunda ex superficie superiore; foliorum rhachi acute angulata, canaliculata, breviter pubescenti; pinnis ca. 8-jugis, glandula magna ad jugorum basim protuberante; foliolis 10–35-jugis, oblongis, 1.2–1.8 cm. longis, 2.5–3 mm. latis, trinerviis, sessilibus, apice minute retusis, utrinque prominenter venulosis, demum glabratis; inflorescentiis partialibus vel spicis in racemis magnis dispositis, racemis 10–25 cm. longis, axillaribus; spicarum pedunculis ca. 1 cm. longis, crassis, basi involucri cupuliforme lobatum vel denticulatum ferentibus, involucri a bracteola minuta subtento, ea constante ex rhachi puberula tenui glandulifera et duabus stipulis ovatis cuspidatis; spicis cylindrico-conicis versus apicem subito ad rhachin nudatam productam attenuatam angustatis; floribus aut perfectis aut staminatis, 1.3–1.5 mm. longis, sessilibus, densissime aggregatis; calyce tubuloso, apice puberulo; corolla tubulosa paululo calyce longiore; staminibus numerosis, inæqualibus basi connatis; legumine atropurpureobruneo, 8–12 cm. longo, stipite rostroque medioeri inclusis, 2 cm. diametro, tereti, inflato, indehiscenti, abrupte cuspidato, fragili, ætate spongioso; seminibus oblongis, 10–13 mm. longis, subcompressis.

A shrub or small tree; branchlets glabrous, glossy; stipular spines blackish, large, 4 to 7 cm. long, 1 to 1.8 cm. wide at base, rounded below, slightly rounded above, strongly winged, attenuate to a sharp rigid point, hollow except for a stalked knob-like intrusion from the upper surface, inhabited by ants; rhachis of leaf sharply angled, canaliculate, short-pubescent; pinnæ about 8 pairs, with a large protruding gland at base of each pair; leaflets 10 to 35 pairs, oblong, 1.2 to 1.8 cm. long, 2.5 to 3 mm. wide, trinerved, sessile, apex minutely retuse, prominently veined on both surfaces, glabrous with age; inflorescence spicate, with spikes in large racemes, the racemes 10 to 25 cm. long, axillary; peduncles of spikes 1 cm. or less in length, thick, bearing a cup-shaped, shallowly lobed or dentate involucre at the base, subtended by a stalked gland and two minute cuspidate bracts; spikes cylindrical, cone shaped, 3 to 5.5 cm. long, apex abruptly narrowed, attenuate, recurved; flowers perfect or staminate, 1.3 to 1.5 mm. long, crowded, sessile, borne on a thickened axis; calyx tubular, puberulent at apex; corolla tubular, slightly longer than calyx; stamens numerous, unequal, filaments united at base; legume dark reddish-brown, 8 to 12 cm. long, including stalk and beak, 2 cm. in diameter, terete, inflated, indehiscant, with a thin fragile shell, abruptly long-cuspidate, spongy in age; seeds oblong, 10 to 13 mm. long, somewhat flattened.

Type in the Herbarium of the University of Michigan, *Mercedes Aguilar H. 495*, collected near San Diego on the Rio Pasion, Department of Petén, Guatamela, April 10, 1935; vernacular name "*cruzetillo*."

*A. mayana* is apparently referable to the genus *Tauroceras* of Britton and Rose.<sup>1</sup> The large blackish winged spines, and the long axillary racemes of spikes are among the notable characters which distinguish this outstanding species.

THE TWO-PETALED SPECIES OF *Bauhinia* IN MEXICO AND CENTRAL AMERICA

In the identification of specimens of the two-petaled species of *Bauhinia* recently collected in British Honduras and Oaxaca, a study was made of *B. dipetala* Hemsl. and *B. deserti* (Britt. & Rose) Lundell. Certain characters which clearly separate the two species were not pointed out in the original descriptions, hence I give the following complete diagnoses.

*Bauhinia dipetala* Hemsl. Diag. Pl. Mex. 48. 1880.

A shrub 2 to 4 meters high; branchlets slender, glabrescent; stipules ovate, long-cuspidate, 1.5 to 4 mm. in length; petioles 1.5 to 3 cm. long, slender, shallowly canaliculate, glabrescent; leaf

<sup>1</sup> N. Amer. Flora 23 : 85. 1928.

blades subchartaceous, broadly ovate, 5 to 12 cm. long, truncate or rounded at the base, rarely shallowly cordate, 7- to 9-nerved, glabrous above, strigillose beneath, shallowly 2-lobed or rarely lobed to the middle, apex of lobes rounded or obtusish, the sinus acutish; inflorescence racemose; pedicels 3 to 6 mm. long; calyx spathiform, 10 to 18 mm. long, split to within 4 mm. of base, ligulate limb 5.5 mm. wide at base, strongly 5-nerved, thin, pubescent with short appressed hairs, greenish, rounded to a 5-cleft apex consisting of the 5 acuminate free calyx tips, each 2 mm. long or less, base of ligulate part of calyx with thickened nectarial ring all around inside at point of adnation with staminodial tube; the 2 petals vestigial, green, 5 to 9 mm. long, pilose, linear-subulate, adnate at base of the fertile stamen to the staminodial tube; the solitary long green stamen forming a firm closed tube with the 9 laterally fused staminodia, the longest staminodia being the 2 adjoining the stamen, with free acuminate apex 2.5 mm. long on staminodial side, 3.5 to 5 mm. long on staminal side, shortest staminodium 5 mm. long, greatest length of staminodial tube 7.5 mm., crowned by falcate-acuminate free tips of staminodia, staminodial tube pilose within at apex with long hairs or glabrescent; fertile filaments in unopened bud 6 to 10 mm. long, growing rapidly after the flower opens to length of 15 to 20 mm., glabrous, fleshy, terete; anthers 6 to 9 mm. long, pilose with long wavy hairs; ovary pubescent, borne on a long glabrous stipe; the legume appressed-puberulent or glabrate, about 15 cm. long, 10 to 15 mm. wide, its stipe 2 to 2.3 cm. long.

#### SPECIMENS EXAMINED:

Mexico. Vera Cruz: Valley of Cordova, *Bourgeau 1713*, type; *2119*. Zacapan, *Purpus 8163*. Atoyac, *Duges* in 1905.

British Honduras. El Cayo District: El Cayo, *Lundell 6136*; *Bartlett 11966*.

Britton and Rose<sup>1</sup> report *B. dipetala* as occurring in Cuba.

Around El Cayo, British Honduras, the species is a shrub 2 to 4 meters high and reaching a diameter of 7.5 cm. The flowers are green with the odor of cabbage. These collections, the first records for Central America, agree in every essential character with the type.

***Bauhinia deserti*** (Britt. & Rose) Lundell, comb. nov.

*Casperea deserti* Britt. & Rose, N. Amer. Flora 23 : 216. 1930.

A shrub 3 to 5 meters high; branchlets covered with short appressed pubescence; stipules small, broadly ovate, long-cuspidate, 1.5 to 2.5 mm. in length; petioles slender, 2 to 4 cm. long, puberulent, shallowly canaliculate; leaf blades subcoriaceous, broadly ovate-suborbicular or ovate-quadrangular, often with nearly parallel sides, 2.5 to 9 cm. long, shallowly cordate or truncate at base, 9- to 11-nerved, dark green and glabrous above, paler and strigillose or puberulent beneath, deeply 2-lobed to below the middle or rarely with some leaves shallowly lobed, the lobes spreading, 1 to 6 cm. long, obtuse or rounded, the sinus obtusish or rounded; inflorescence long-racemose; the pedicels 4 to 15 mm. long; hypanthium 6 to 13 mm. long; calyx spathiform, 12 to 24 mm. long, width of ligulate calyx limb 8 to 11 mm. at base, apex hairy with five acuminate free tips, greenish outside, strongly 5-nerved, with 5 ribs slightly elevated on surface, pubescent with short appressed or slightly crispate purple-brown hairs, base of ligulate part of calyx with 5 massive fleshy irregular nectaries inside at point of adnation with staminodial tube; the 2 petals green, linear, 6 to 18 mm. long, densely pilose with long wavy brownish hairs; staminodial tube 4.5 to 13 mm. long, subcartilaginous, with visible main nerves, at apex irregularly dentate with knob-tipped teeth 1 to 3.5 mm. long, glabrous or sparsely pilose outside, conspicuously pilose within at apex with long wavy purple-brown hairs; filament of fertile stamen fleshy, terete, 22 to 35 mm. long (including adnate part); anthers green, 7.5 to 12 mm. long, slightly pilose on outer side with long wavy hairs or rarely glabrous; ovary long-stipitate, pubescent, the stipe glabrous; the legume puberulent, 10 to 18 cm. long, 10 to 15 mm. wide, its stipe 2.5 to 3.5 cm. long.

<sup>1</sup> N. Amer. Flora 23 : 216. 1930.

## SPECIMENS EXAMINED:

Mexico. Puebla: Tehuacan, *Rose* 11375, type; 5886, 9924, 9977; *Pringle* 9333; *Holway* in 1903. Oaxaca: Monte Alban, *Conzatti* 4791, 565; *Pringle* 6065; *Smith* 350. Las Naranjas, *Purpus* 2669. El Parian, *Conzatti* 1926.

*B. deserti* appears to be restricted to the highlands of Puebla and Oaxaca.

The species is quite variable, especially in flower size. However, differences of flower size from individual plants are scarcely greater than differences apparent in flowers within a single inflorescence (see *Pringle* 6065). *B. deserti* is very closely related to *B. dipetala* from which it differs most obviously in leaf form and size of flowers. The leaves of *B. deserti* are much thicker with deeper sinuses and spreading lobes; the flowers are on the average much larger, and have knobbed teeth on the staminodial tubes.

***Cassia deamii*** (Britt. & Rose) Lundell, comb. nov.

*Grimaldia deamii* Britt. & Rose, N. Amer. Flora 23 : 300. 1930.

## SPECIMENS EXAMINED:

British Honduras. El Cayo District: Mountain Pine Ridge, Rio On, *Lundell* 6782; Rio Privacion, *Bartlett* 11855.

A shrub 1 to 3 meters high; common in the open rocky stream beds of the Mountain Pine Ridge.

***Cassia gaumeri*** (Britt. & Rose) Lundell, comb. nov.

*Peirania gaumeri* Britt. & Rose, N. Amer. Flora 23 : 263. 1930.

***Cassia gualanensis*** Lundell, nom. nov.

*Peirania deamii* Britton, N. Amer. Flora 23 : 261. 1930.

***Cassia rovirosana*** (Britt.) Lundell, comb. nov.

*Chamæcrista rovirosana* Britton, N. Amer. Flora 23 : 292. 1930.

***Cassia tabascoensis*** (Britt. & Rose) Lundell, comb. nov.

*Chamæcrista tabascoensis* Britt. & Rose, N. Amer. Flora 23 : 299. 1930.

## CELASTRACEÆ

***Rhacoma gentlei*** Lundell, sp. nov.

Frutex vel arbor, 2-5-metralis; folia glabra, anguste oblanceolata, 2.5-4.5 cm. longa, 6-13 mm. lata, apice mucronato-obtusa vel acuta, basi cuneata, serrulata; petiolis 2.5-3.5 mm. longis; inflorescentiæ cymosæ, axillares, 2.5-5 cm. longæ (pedunculo 1.5-3.5 cm. longo incluso), ramis sparse puberulis; pedicelli 6-10 mm. longi; sepala 4, depresso-orbicularia, 0.6-0.8 mm. longa, ca. 1 mm. lata, puberula; petala 4, suborbicularia, 2 mm. lata; stamina 4, filamentis ca. 0.5 mm. longis; discus 4-lobus, planiusculus, staminibus lobis alternis; ovarium 2-loculare; fructus immaturus, obovatus, 8-10 mm. longus, asymmetricus, verrucosus.

Shrub or small tree, 2 to 5 meters high; branchlets quadrangular, glabrous; petioles 2.5 to 3.5 mm. long, glabrate; leaf blades glabrous, membranous, narrowly oblanceolate, 2.5 to 4.5 cm. long, 6 to 13 mm. wide, apex mucronate-obtuse or acute, base cuneate, margin serrulate; inflorescence cymose, axillary, solitary, 2.5 to 5 cm. long (including peduncle), the branches sparsely puberulus, flowers 14 or less; main peduncle 1.5 to 3.5 cm. long; pedicels 6 to 10 mm. long, glabrous;

sepals 4, depressed-orbicular, 0.6 to 0.8 mm. long, about 1 mm. wide, in two opposite pairs, outer pair slightly smaller than inner pair, minutely erose, puberulus; petals 4, suborbicular, 2 mm. wide, minutely erose, reflexed, wine colored, glabrous; stamens 4, opposite the sepals, inserted between lobes of disk; filaments about 0.5 mm. long, extrorse; disk nearly plane, 4-lobed; ovary 2-celled; style short; stigma minutely bifid; immature fruits 8 to 10 mm. long, asymmetrically obovoid, verrucose.

Type in the Herbarium of the University of Michigan, *Percy H. Gentile 1527*, collected in forest on limestone hill at Gracie Rock on the Sibun River, Belize District, British Honduras, March 26, 1935.

***Rhacoma riparia* Lundell, sp. nov.**

Frutex vel arbor, 5-metralis, glabra; folia oblanceolata vel anguste elliptico-oblanceolata, 4.5–9 cm. longa, 1.3–2.4 cm. lata, apice acuta, basi cuneata, crenulato-serrulata; petiolis 2–3 mm. longis; inflorescentiæ cymosæ, axillares, 2–3 cm. longæ (pedunculo 1.5–2.5 cm. longo incluso); pedicelli 3–6 mm. longi; sepala 4, orbiculari-ovata, ca. 0.7 mm. longa, 0.8 mm. lata; petala 4, suborbicularia, ca. 2 mm. lata; stamina 4, filamentis ca. 0.3 mm. longis; discus 4-lobus, planiusculus, staminibus lobis alternis; ovarium 2-loculare; fructus obovatus, ca. 9 mm. longus, asymmetricus, verrucosus.

Shrub or small tree 5 meters high, entirely glabrous; branchlets quadrangular; petioles 2 to 3 mm. long; leaf blades membranous, oblanceolate or narrowly elliptic-oblanceolate, 4.5 to 9 cm. long, 1.3 to 2.4 cm. wide, apex acute, base cuneate, margin obscurely crenulate-serrulate; inflorescence cymose, axillary, solitary, 2 to 3 cm. long (including peduncle), flowers 14 or less; main peduncle 1.5 to 2.5 cm. long; pedicels 3 to 6 mm. long; sepals 4, orbicular-ovate, about 0.7 mm. long, 0.8 mm. wide, minutely erose; petals 4, suborbicular, about 2 mm. wide, minutely erose, reflexed, wine colored; stamens 4, opposite the calyx lobes, inserted between lobes of disk; filaments about 0.3 mm. long, extrorse; disk nearly plane, 4-lobed; ovary 2-celled; stigma subsessile, minutely bifid; fruit obovoid, about 9 mm. long, asymmetrical, verrucose.

Type in the Herbarium of the University of Michigan, *C. L. Lundell 1476*, collected at edge of San Pedro de Martir River below El Paso, Department of Petén, Guatemala, April 10, 1932.

***Rhacoma riparia* var. *puberula* Lundell, var. nov.**

Frutex; folia anguste lanceolata vel elliptico-lanceolata, 2.5–7 cm. longa, 0.9–2.4 cm. lata, apice acuta vel acuminata, basi cuneata, serrulata; petiolis 1–3 mm. longis; inflorescentiæ cymosæ, axillares, 1.5–2.5 cm. longæ (pedunculo 0.7–1.4 cm. longo incluso); pedicelli ca. 7 mm. longi; sepala 4, orbiculari-ovata, 0.5–1 mm. longa, 0.7–1 mm. lata, puberula; petala 4, suborbicularia, ca. 2 mm. lata; stamina 4, filamentis ca. 0.5 mm. longis; discus 4-lobus, planiusculus, staminibus lobis alternis; ovarium 2-loculare; fructus obovatus, ca. 9 mm. longus, asymmetricus, verrucosus.

Shrub; branchlets quadrangular, glabrous; petioles 1 to 3 mm. long, sparsely puberulus; leaf blades membranous, narrowly lanceolate or elliptic-lanceolate, 2.5 to 7 cm. long, 0.9 to 2.4 cm. wide, apex acute or acuminate, base cuneate, margin serrulate, costa sparsely puberulus; inflorescence cymose, axillary, solitary, 1.5 to 2.5 cm. long (including peduncle), the branches glabrate, 7-flowered; main peduncle 0.7 to 1.4 cm. long; pedicels about 7 mm. long; sepals 4, unequal, orbicular-ovate, 0.5 to 1 mm. long, 0.7 to 1 mm. wide, minutely erose, puberulus; petals 4, suborbicular, 2 mm. wide, minutely erose, reflexed, wine colored; stamens 4, opposite the calyx lobes, inserted between lobes of disk; filaments about 0.5 mm. long, extrorse; disk 4-lobed, nearly plane; ovary 2-celled; stigma subsessile, minutely bifid; fruit obovoid, about 9 mm. long, asymmetrical, verrucose, wine colored.

Type in the Herbarium of the University of Michigan, *Percy H. Gentile 871*, collected on the bank of Northern River near Prospecto, Belize District, British Honduras, Nov. 13, 1933.

**ADDITIONAL SPECIMENS EXAMINED:**

British Honduras. Belize District: Northern River, *Gentile 1298*.



## VITACEÆ

MEXICAN AND CENTRAL AMERICAN SPECIES OF *Ampelocissus*

Only one species of *Ampelocissus* (*A. acapulcensis*) has been unquestionably recognized on the continent. In his monographic treatment, Planchon<sup>1</sup> described *A. erdwendbergii* from Mexico, but stated that he was doubtful whether the species was distinct from *A. acapulcensis*. A critical study of ample flowering and fruiting material, collected during the past five decades in southern Mexico and Central America, reveals that *A. erdwendbergii* is clearly distinct from *A. acapulcensis*. Flowers from the type of *A. erdwendbergii* (Erdwendberg 376) in the U. S. National Herbarium agree exactly with flowering material collected in Yucatan by Dr. G. F. Gaumer. Specimens from Costa Rica, previously referred to *A. acapulcensis*, represent a third species which apparently is undescribed. The three species may be separated as follows.

- Ovary in staminate flowers spinulose; pedicels glabrous, 2 to 3 mm. long; petals 2.5 to 3 mm. long.....1. *A. erdwendbergii*  
 Ovary in staminate flowers glabrous  
     Pedicels hirtellous, about 1.5 mm. long; petals 1.8 to 2.1 mm. long; inflorescence very crowded, densely rufous-lanate.....2. *A. acapulcensis*  
     Pedicels glabrous or obscurely papillate, 1.2 to 3.1 mm. long; petals 2.5 to 3 mm. long; inflorescence loose, sparsely lanate.....3. *A. costaricensis*

1. *Ampelocissus erdwendbergii* Planch. DC. Monogr. Phan. 5 : 404. 1887.

A woody vine; internodes of younger shoots 20 to 30 cm. long, about 5 mm. thick, striate reddish-brown, hollow, diaphragm present, nodes slightly enlarged; stems and tendrils with white floccose covering when young, glabrescent in age; tendrils intermittent, weak, slender, repeatedly unilaterally dichotomous; petioles not over 6.5 cm. long, covered with dense white indument except on a pink dorsal line; leaf blades cordate-oblong to cordate-ovate, 6 to 15 cm. wide, about as long as broad, very shallowly 3-lobed to palmately lobed, sinuses generally broad, the petiolar sinus deep and narrow, apical lobe large, acute and triangular to ovate, margins doubly serrate with tips of the teeth subcartilaginous, nearly destitute of pubescence and introrsely falcate, the upper blade surface pilose and olive green with margin and veins pinkish, the lower surface densely tomentose, ferruginous, the veins pilose; staminate inflorescence large, loose, and open, cymose, 20 to 45 cm. long, bearing unilaterally dichotomous tendrils; peduncles weak, slender; terminal cymes 7-flowered; pedicels glabrous or glabrescent, slender, 2 to 3 mm. long; calyx minute, 5-dentate; petals 5, ovate-oblong, 2.5 to 3 mm. long, acute, glabrescent; stamens 5; filaments slender, somewhat flattened, about 2 mm. long; anthers small, 2-celled; disk fleshy, obscurely 10-striate, connate to base of ovary; ovary subglobose, spinulose; style short, thick, cylindrical; peduncle of infructescence branching when 10 to 15 cm. long to form a tendril and a fruiting cluster; cluster as much as 20 cm. wide, spreading, loose, divided into three or more nearly equal sections; berries somewhat pyriform, when dry 5 to 10 mm. wide, 5 to 8 mm. long, red, with very little pulp; seeds 1 to 4, obcordate, about 5 mm. long and broad, deeply grooved on dorsal side.

SPECIMENS EXAMINED:

Mexico. Without locality, *Erdwendberg* 376 (fragment of type). Yucatan: without locality, *Gaumer* 23942, 23985, 24034, and Buena Vista in 1899. Tamaulipas: Tampico, *Palmer* 331.

<sup>1</sup> Planchon in DC. Monogr. Phan. 5 : 368. 1887.

Guatemala. Department of Petén: La Libertad, *Lundell 3425; Aguilar 323*; vernacular name "*bejuco de uva*."

2. *Ampelocissus acapulcensis* (H. B. K.) Planch. DC. Monogr. Phan. 5 : 403. 1887.

*Vitis acapulcensis* H. B. K. Nov. Gen. & Sp. 7 : 230. 1825.

A large woody vine; older stems, young shoots, tendrils, and peduncles floccose; tendrils intermittent; petioles 1 to 5 cm. long, densely hairy when young; leaf blades broadly cordate, 6 to 16 cm. long, acute, erose-dentate, often shallowly 3-lobate, when young densely rufous-lanate beneath, less hairy above; staminate inflorescence long-pedunculate, very crowded, 4 to 8 cm. wide, the branches densely rufous-lanate; flowers small, reddish-brown; pedicels about 1.5 mm. long, hirtellous; calyx obscurely and shallowly 5-lobed, minutely erose, membranous, glabrescent; petals 5, ovate, 1.8 to 2.1 mm. long, acute, glabrous; stamens 5, about 2 mm. long, attached at base of disk; filaments almost terete; anthers small, 2-celled; disk less than 1 mm. in height, 10-striate, glabrous; ovary subglobose-conical, partially enclosed by the connate disk, 10-striate, glabrous, 2-celled, each cell with 2 ovules; style short, thick, conical, 10-striate; infructescence large, with thick woody peduncle; clusters as much as 25 cm. wide; fruit wine colored, globose, 12 to 25 mm. in diameter.

SPECIMENS EXAMINED:

Mexico. Guerrero: Acapulco, *Palmer 364*; Rio Bolsas, *Nelson 7086*. Morelos: Yantepec, *Pringle 8503; Rose & Hay 5349*.

Salvador. Department of Sonsonate: Acajutla, *Standley 21982*; without locality, *Calderon 1678*. Department of San Vicente, *Standley 21634*.

3. *Ampelocissus costaricensis* Lundell, sp. nov.

Frutex grandis alte scandens; ramis cirrhis pedunculisque striatis, novellis sparsim floccosis, ætate glabrescentibus; cirrhis intermittentibus repetite unilateriterque dichotomis; petiolis 3.5–10 cm. longis, gracilibus; foliis membranaceis, cordatis, 10–15 cm. latis longisque, acutis vel acuminatis, subtus lanosis, supra glabrescentibus, ad apices venarum lateralium conspicue dentatis, inter venas solum denticulatis, plerumque sed non profunde trilobatis vel quinquelobatis, lobis acutis vel acuminatis; pedunculis lignescentibus, supra basin 3–20 cm. ferentibus cirrhum et inflorescentiam; inflorescentia mascula paniculata, laxa, 6–20 cm. expansa, ramulis hirtellis etiamque sparsim lanatis; pedicellis 1.2–3.1 mm. longis; floribus colore vinaceis, glabris; calyce minuto, obscuro 5-partito vel integro; petalis 5 (vel 6), ovato-oblongis, 2.5–3 mm. longis, apice canaliculatis, inflexis; staminibus 5 (vel 6), ca. 2.3 mm. longis, ad disci basin affixis; filamentis carnosius, teretiusculis, pallide rubris, apice abrupte angustatis; antheris parvis late ovatis, luteis, 2-cellulis; disco annuliformi, magno, carnosio, apice 10-crenuloso, rubro, ca. 1.3 mm. alto, ex basi duabus partibus a filamentis profunde 5-impressis et inter filamenta leviuscule lineatim 5 inflexis; ovario a disco connato valde circumvallato, 2-cellulo; cellulis biovulatis; stylo crasso, brevi, truncato.

A large woody vine; stems, tendrils, and peduncles striate, sparsely floccose when young, glabrescent with age; tendrils intermittent, repeatedly unilaterally dichotomous; petioles 3.5 to 10 cm. long, slender; leaf blades membranous, cordate, 10 to 15 cm. wide, about as long as broad, acute or acuminate, lanate beneath, glabrescent above, dentate, often shallowly 3- to 5-lobate, the lobes acute or acuminate; peduncles woody, branching 3 to 20 cm. from base to form a tendril and the inflorescence; the staminate inflorescence paniculate, 6 to 20 cm. wide, somewhat loose, the branches hirtellous and sparsely lanate; pedicels 1.2 to 3.1 mm. long; flowers wine-colored, glabrous; calyx minute, obscurely 5-parted or entire; petals 5 (rarely 6), ovate-oblong, 2.5 to 3 mm. long, apex canaliculate, inflexed; stamens 5 (rarely 6), about 2.3 mm. long, attached at base of disk; filaments fleshy, almost terete, reddish, abruptly narrowed at apex; anthers small, ovate, 2-celled; disk annular, large, fleshy, apex 10-crenulate, red, about 1.3 mm. in height, 10-ribbed to

base by 5 deep and 5 shallow fissures, the former opposite the filaments; ovary encased by the connate disk, 2-celled, each cell with 2 ovules; style thick, short, truncate.

Type in the U. S. National Herbarium, No. 861600, collected in Costa Rica (United Fruit Company 383).

#### ADDITIONAL SPECIMENS EXAMINED:

Costa Rica. Salamanca, *Tonduz 9615*; without locality, *Pittier 8640*; "Atlantic region," *Alfaro* in 1935.

On U. S. National Herbarium specimen No. 1381316 (*Pittier 8640*) a packet of loose fruits is attached with the following label: "*Tonduz 7965, Vitis acapulcensis*, collected in the forest of Rio Naranjo, Costa Rica." The fruits are globose, 5 to 7 mm. in diameter, 2-seeded; the seeds are obovoid, about 3.5 mm. long. I doubt that these fruits belong to *A. costaricensis*. The collection of Professor A. Alfaro has fruits which are subglobose, 15 to 20 mm. in diameter with obovoid seed 12 to 14 mm. long. The latter probably belong to *A. costaricensis*.

#### MYRTACEÆ

##### *Eugenia gentlei* Lundell, sp. nov.

Arbor parva; ramis foliisque glabris; ramulis acute quadrangulis anguste alatis; foliis 4-7.3 cm. longis, 2-3.5 cm. latis, coriaceis, subsessilibus, ellipticis vel anguste ellipticis, apice obtusis, basi acutiusculis, supra olivaceo-viridibus, subtus pallidioribus, venis lateralibus obscuris; fructibus (juvenilibus solum visis) solitariis sessilibus, subglobosis, glabris, siccitate nigris; calyce persistenti 4- (raro 3-) partito, lobis ovato-oblongis, 3.5-4 mm. longis, apice rotundatis, ciliatis; ovario (ut videtur) 2-cellulo.

A small tree; branches and foliage glabrous; branchlets quadrangular, slightly winged; leaves small, coriaceous, subsessile; blades elliptic to narrowly elliptic, 4 to 7.3 cm. long, 2 to 3.5 cm. wide, apex obtuse, base acutish, olive-green above, much paler beneath, lateral nerves obscure; young fruits solitary, sessile, subglobose, glabrous, drying black; persistent calyx 4- or rarely 3-parted, the lobes ovate-oblong, 3.5 to 4 mm. in length, rounded at apex, ciliate; ovary apparently 2-celled.

Type in the Herbarium of the University of Michigan, *Percy H. Gentle 1684*, collected in secondary forest at Gracie Rock on the Sibun River, Belize District, British Honduras, July 15, 1935.

The species is notable for its quadrangular branchlets, small subsessile leaves, and solitary sessile fruits.

#### EBENACEÆ

##### SPECIES OF *Diospyros* IN THE YUCATAN PENINSULA

Of the eight species of *Diospyros* in the Yucatan Peninsula, seven are endemic. *D. ebenaster* is cultivated and apparently naturalized.

The endemics are known chiefly from fruiting material, and the determination of exact relationships is therefore difficult. When more specimens become available, especially flowering ones, it is probable that one or more of the supposed species may not prove to be valid. As a whole the family is very poorly represented in herbaria.

The six species now recognized from the region and the two here proposed as new may be separated as follows.

Flowers usually 3-parted, rarely 4-parted

Shrub 2 to 5 meters high; foliage densely fulvous-pubescent; fruiting peduncles

about 2 mm. long; fruiting calyx 15 to 18 mm. wide. . . . . 1. *D. yucatenensis*

- Erect tree 5 to 12 meters high; foliage sparsely pubescent, becoming glabrate;  
 fruiting peduncles 5 to 10 mm. long; fruiting calyx 18 to 24 mm. wide. . . . . 2. *D. spectabilis*
- Flowers usually 4-parted, rarely 5- to 6-parted
- Leaves 10 to 30 cm. long
- Fruits less than 3 cm. in diameter. . . . . 3. *D. yatesiana*
- Fruits 4 to 7 cm. in diameter. . . . . 4. *D. ebenaster*
- Leaves smaller, not exceeding 10 cm. long
- Fruiting calyx 9 to 13 mm. wide, shallowly lobed; lobes rounded; leaves  
 4 to 9.5 cm. long
- Petioles 5 to 7 mm. long; leaf blades oblong-ob lanceolate. . . . . 5. *D. schippii*
- Petioles 2 to 3 mm. long; leaf blades cuneate-obovate. . . . . 6. *D. cuneata*
- Fruiting calyx 15 to 18 mm. wide, deeply lobed; lobes acutish or obtusish;  
 leaves less than 5.5 cm. long
- Leaf blades cuneate-spatulate, 0.8 to 1.5 cm. wide. . . . . 7. *D. bumelioides*
- Leaf blades obovate, 1.2 to 4 cm. wide. . . . . 8. *D. anisandra*

1. *Diospyros yucatanensis* Lundell, sp. nov.

Frutex 2-5-metralis, ramulis gracilibus molliter fulvis; petiolis 3-4.5 mm. longis; laminis oblanceolatis vel obovato-lanceolatis, 4-7 cm. longis, 1.4-2.5 cm. latis, apice acutis, basi acutis vel obtusiusculis, fulvo-viridibus, dense persistenter molliter pubescentibus, subtus minute punctatis; floribus pistillatis axillaribus, solitariis, trimeribus vel raro tetrameribus; pedicellis 1.5-3 mm. longis, crassis, apice bracteam 3 mm. longam oblanceolatam ferentibus; calyce trilobo crasso, 6-7 mm. longo, extus dense fulvo, intus minute punctato etiam basi appresso-hirsuto, sed superiore parte solum fulvo-pubescenti, lobis late rotundatis, 3-4 mm. longis, 5 mm. latis, patentibus, obscure costatis, submucronatis; corolla urceolata, ca. 8 mm. longa, extus dense appresse hirsuta, intus glabra, triloba, lobis imbricatis, demum patentibus, late ovatis, 3 mm. longis, 2.2 mm. latis, acutiusculis; staminodiis 3, ad corollae basin adnatis, 4 mm. longis, cum corollae segmentis alternantibus; ovario subglobose-conico, dense hirsuto, 6-septato; stylo crasso, 1-1.5 mm. longo, hirsuto; stigmate trifido, conspicuo, albo; cymis staminatis brevibus, axillaribus, 2-3-floris (raro unifloris); floribus masculis profunde trilobis, breviter pedicellatis, a 1 vel 2 bracteis angustis subtensis, 3-partitis (raro 4-partitis); calyce ca. 8.5 mm. longo, extus dense fulvo intus infima parte hirsuto sursum pubescenti, lobis ovatis ca. 5 mm. longis, 2.5-4 mm. latis, acutis; corolla ca. 14 mm. longa, quam pistillata sensim majore; staminibus 12-14, inaequalibus, ad corollae basin affixis, glabris; fructibus breviter pedunculatis, subglobois, 2-2.4 cm. diam., maturitate glabris, levibus; pedunculis crassis 2 mm. longis; calyce persistenti 15-18 mm. lato, fulvo-pubescenti, lobis rotundatis, 5-7 mm. longis, obscure costatis; seminibus 6 subcompressis, asymmetrice oblongis, 11-13 mm. longis, 6-7 mm. latis.

A fulvous pubescent shrub 2 to 5 meters high; branchlets slender; petioles 3 to 4.5 mm. long; leaf blades oblanceolate or lanceolate-obovate, 4 to 7 cm. long, 1.4 to 2.5 cm. wide, apex acute, base acutish or obtuse, yellow-green, with dense, soft, velvety, persistent, fulvous pubescence on both surfaces, minutely punctate beneath; pistillate flowers axillary, solitary, 3- rarely 4-parted; pedicels 1.5 to 3 mm. long, thick, bearing an oblanceolate bract 3 mm. long at apex; calyx thick, 6 to 7 mm. long, densely fulvous pubescent outside, minutely punctate, appressed-hirsute within at base, fulvous pubescent above, deeply 3-lobed, the lobes suborbicular, 3 to 4 mm. long, about 5 mm. wide, rounded, submucronate, obscurely ribbed, thick, spreading; corolla urceolate, about 8 mm. long, densely appressed-hirsute outside, glabrous within, 3-lobed, the lobes imbricate, broadly ovate, about 3 mm. long, 2.2 mm. wide, acutish, spreading; the 3 rudimentary stamens about 4 mm. long, attached at base of corolla, alternate with the lobes; ovary subglobose-conical, densely hirsute, 6-celled; style thick, 1 to 1.5 mm. long, hirsute; stigma trifid, large, white; staminate cymes short, axillary, 2- 3- or rarely 1-flowered; flowers short pedicellate, subtended by 1 to 2 narrow bracts, 3- rarely 4-parted; calyx about 8.5 mm. long, densely fulvous pubescent outside, hirsute within below, pubescent above, deeply 3-lobed, the lobes ovate, about 5 mm. long, 2.5 to 4 mm. wide, acute; corolla about 14 mm. long, somewhat larger than in the pistillate flowers; stamens 12 to 14, unequal in length, attached at base of corolla, glabrous; fruits subglobose, 2 to 2.4 cm. in diameter, glabrate and smooth at maturity; fruiting peduncles thick, about 2 mm.

long; fruiting calyx 15 to 18 mm. broad, fulvous-pubescent, the lobes rounded, 5 to 7 mm. long, obscurely ribbed; 6-seeded, the seed asymmetrically oblong, 11 to 13 mm. long, 6 to 7 mm. wide, somewhat flattened.

Type in the Herbarium of the University of Michigan, *C. L. Lundell 3237*, collected on the steep north bank of Lake Petén near San Andres, Department of Petén, Guatemala, May 4, 1933; vernacular name "*jaboncillo*."

#### ADDITIONAL SPECIMENS EXAMINED:

Guatemala. Department of Petén: Sabana Zis, Lake Petén, *Lundell 3194*; La Libertad, *Lundell 3560*.

Mexico. Yucatan: Kancabtsenot, *Gaumer 23862*; without locality, *Gaumer 24089*.

A rather common shrub on calcareous soils in marginal forest.

In the *Flora of Yucatan*,<sup>1</sup> Standley reported the species as *Maba albens* (Presl.) Hiern, a shrub with whitish pubescence.

#### 2. *Diospyros spectabilis* Lundell, sp. nov.

Arbor erecta 12 m. alta, 25 cm. diam.; ramulis gracilibus, primum pubescentibus demum glabratibus; petiolis 3–8 mm. longis, pubescentibus; laminis subchartaceis, lanceolatis vel ovato-lanceolatis, 3.5–9 cm. longis, 2–3.8 cm. latis, apice acutis, supra primum pubescentibus demum glabratibus, subtus subluteo-viridibus, persistenter molliter pubescentibus, minute punctatis; costa et venis lateralibus supra albicantibus, subtus fulvo-pubescentibus; fructibus solitariis, axillaribus, subglobosis, 2–2.3 cm. diam., 6-cellulis, juventute appresse fulvo-hirsutis, maturitate glabratibus, pedunculis crassis, 5–10 mm. longis; calyce persistenti coriaceo, 1.8–2.5 cm. lato, fere usque ad basin trilobo, lobis ovato-rotundis, 1.2–1.4 cm. latis, subacutis, fulvis, extus conspicue venosis, intus griseo-pubescentibus levibusque; seminibus irregulariter oblongis, ca. 1.2 cm. longis, atrorubris, minute rugulosis.

An erect tree 12 meters high and 25 cm. in diameter; branchlets slender, pubescent at first, glabrate with age; petioles 3 to 8 mm. long, pubescent; leaf blades subchartaceous, lanceolate or ovate-lanceolate, 3.5 to 9 cm. long, 2 to 3.8 cm. wide, apex acute, base acutish, the upper surface at first pubescent, but finally glabrate, the lower surface yellow-green, persistently soft-pubescent, minutely punctate, the costa and lateral veins whitened above, prominent and fulvous-pubescent beneath; fruits solitary, axillary, subglobose, 2 to 2.3 cm. in diameter, 6-celled, fulvous appressed-hirsute when young but glabrate at maturity; fruiting peduncles stout, 5 to 10 mm. long; fruiting calyx thickly coriaceous, 1.8 to 2.4 cm. broad, 3-lobed nearly to the base, the lobes ovate-orbicular, 1.2 to 1.4 cm. wide, acutish, fulvous-pubescent, and coarsely veined outside, grayish-pubescent and smooth within; seeds irregularly oblong in outline, about 1.2 cm. in length, dark reddish-black, finely rugulose.

Type in the Herbarium of the University of Michigan, *C. L. Lundell 807*, collected in secondary swamp forest at Tuxpeña, Campeche, Mexico, October 11, 1931.

#### ADDITIONAL SPECIMENS EXAMINED:

Mexico. Campeche: Tuxpeña, *Lundell 926*.

*D. spectabilis* is occasional in logwood swamps (*tintales*) where it is remarkable as an erect tree, standing out from the gnarled twisted vegetation which characterizes the habitat.

Two collections from the Corozal District, British Honduras, *Gentle 232* and *Lundell 4800*, are probably referable to this species. They differ in having sub-

<sup>1</sup> Field Mus. Nat. Hist., Bot. 3: 157. 1930.

coriaceous, less pubescent, grayish leaves, a fruiting calyx 3 cm. in width, and slightly larger fruits.

The collections of *D. spectabilis* were distributed as *Maba veræ-crucis* Standl. The species is distinguished from the latter by leaf form, spreading pubescence, size of fruiting calyx, size of fruit, length of petioles, length of peduncles, and other minor characters.

3. *Diospyros yatesiana* Standl. Carnegie Inst. Wash. Pub. No. 461: 81. 1935.

A tree 15 to 25 meters high, reaching a diameter of 50 cm.; crown large, compact; foliage dense, dark green; petioles 7 to 13 mm. long, puberulus; leaf blades large, chartaceous, elliptic or elliptic-oblong, 11 to 16 cm. in length, 5 to 7 cm. wide, acute or shortly deltoid-acuminate at apex, acutish or obtuse at base, sparsely hirtellous or glabrate above, minutely punctate, glabrate, and prominently nerved beneath; fruits axillary, solitary, subsessile, globose, about 2.3 cm. in diameter, sparsely strigose or glabrate, drying black; fruiting calyx about 15 mm. broad, densely strigose inside and outside, 4-lobed to the middle, the lobes ovate, acute or obtusish.

SPECIMENS EXAMINED:

Mexico. Campeche: Tuxpeña, *Lundell 1309*, type collection; Chan Laguna, *Lundell 1020*.

Occasional on calcareous soils in the sapodilla forest (*zapotal*); sometimes planted as a shade tree.

4. *Diospyros ebenaster* Retz. Obs. Bot. 5: 31. 1789.

A tree 8 to 20 meters high, reaching a diameter of 50 cm.; trunk and branches somewhat blackened; petioles 6 to 10 mm. long; leaf blades large, subcoriaceous, oblong or oblong-elliptic, 10 to 30 cm. long, 4.5 to 6 cm. wide, obtuse or acutish at apex, acutish at base, glabrous; fruits solitary, axillary, subglobose, 3.5 to 7.5 cm. in diameter, drying black; fruiting peduncles short, thick; fruiting calyx about 3.5 cm. wide, puberulus, 5-lobed, the lobes ovate, undulating.

SPECIMENS EXAMINED:

Mexico. Yucatan: Hacienda Akum, *Gaumer 23274*; vernacular name "*tauch ya*."

British Honduras. Orange Walk District: Honey Camp, *Lundell 502*; vernacular name "*zapote negro*." Belize District: Maskall, Northern River, *Gentle 1187*; vernacular name "black sapodilla."

Planted for its edible fruits, and found occasionally on sites of abandoned villages. It is apparently naturalized, but doubtfully native. In the Yucatan Peninsula the species appears to prefer calcareous soils.

5. *Diospyros schippii* Standl. Carnegie Inst. Wash. Pub. No. 461: 81. 1935.

A tree 15 meters high, and 20 cm. in diameter; petioles 5 to 7 mm. long, canaliculate, glabrate; leaf blades subcoriaceous, oblong-lanceolate, 6 to 9.5 cm. long, 1.5 to 3.5 cm. wide, narrowed at both ends, apex obtuse, base acutish, glabrous above, glabrate and minutely punctate beneath with prominent costa and inconspicuous lateral veins; fruits solitary, subglobose, about 15 mm. in diameter, glabrate with age; fruiting peduncles about 6 mm. long; fruiting calyx about 9 mm. wide, sparsely strigillose, 4-lobed, the lobes shallow, rounded at apex.

## SPECIMEN EXAMINED:

British Honduras. British Honduras-Guatemala boundary survey: Camp 34, *Schipp 1281*, type collection.

Concerning the tree the collector states: "Large tree with rather a compact crown, growing on hillside in forest shade. Fruits brown, wood hard and close grained, dark brown color. Rare."

6. *Diospyros cuneata* Standl. Field Mus. Nat. Hist., Bot. 8: 33. 1930.

A shrub; petioles 2 to 3 mm. long, strigillose but soon glabrate; leaf blades subcoriaceous, cuneate-obovate, 4 to 8.5 cm. long, 1.5 to 3 cm. wide, apex rounded or obtuse, base cuneate, glabrescent above, strigillose when young but soon glabrate beneath, margin slightly revolute; staminate flowers in axillary 3- to 4-flowered cymes; pedicels 1 to 2 mm. long, densely sericeous; calyx campanulate, about 3 mm. long, sericeous outside, glabrous within, shortly 4-lobed, the lobes deltoid or rounded; corolla hypocrateriform, densely sericeous outside, glabrous within, 7 to 9 mm. long, 4-lobed, the lobes ovate, about 3.5 mm. long; stamens 8, in 4 pairs, the shorter inner pairs 3 mm. long, the outer pairs 5 mm. long, glabrous; fruits solitary, axillary, globose, about 15 mm. in diameter, sericeous, glabrate at maturity, 4-celled; fruiting peduncles about 3 mm. long; fruiting calyx 11 to 13 mm. wide, 4-lobed, the lobes rounded at apex, sparsely strigillose outside, densely sericeous within.

## SPECIMENS EXAMINED:

Mexico. Yucatan: without locality, *Gaumer 24098*, type collection; Progreso, *Steere 3098*.

British Honduras. Corozal District: Corozal, *Gentle 292*.

Apparently a rather common shrub.

7. *Diospyros bumelioides* Standl. Tropical Woods 18: 31. 1929.

A shrub 3 to 5 meters high; branchlets very slender, wiry; leaves small, coriaceous, subsessile, clustered at apices of branchlets; leaf blades cuneate-spatulate, 2.5 to 4 cm. long, 0.8 to 1.5 cm. wide, apex emarginate or rounded, base long attenuate, cinereous and obscurely puberulus above, glabrate and opaque below, with a prominent costa and obscure lateral veins, margin slightly revolute; fruits solitary, globose, about 1.3 cm. in diameter, sparsely sericeous, glabrate at maturity; fruiting peduncles short, about 3 mm. long; fruiting calyx cinereous and sparsely appressed pubescent outside or glabrate, puberulus within, 15 to 18 mm. wide, deeply 4- to 5-lobed, the lobes ovate, obtusish, recurved.

## SPECIMENS EXAMINED:

British Honduras. Orange Walk District: Honey Camp, *Lundell 137*, type collection; *342*.

Mexico. Campeche: Tuxpeña, *Lundell 864*.

A wiry shrub of the logwood swamps (*tintales*); rare in British Honduras, rather common in Campeche.

8. *Diospyros anisandra* Blake. Proc. Biol. Soc. Washington 34: 44. 1921.

A glabrous shrub about 3 meters high; petioles 1 to 2 mm. long, glabrous; leaf blades chartaceous, obovate or obovate-orbicular, 2.5 to 5.5 cm. long, 1.2 to 4 cm. wide, apex retuse, base cuneate, glabrous except for a few short hairs at base of blade on upper side; fruits solitary, globose, about 12 mm. in diameter, glabrous, drying black; fruiting peduncles slender, about 5 mm. long; fruiting calyx glabrous, 15 to 18 mm. wide, deeply 4- to 5-lobed, the lobes narrow, attenuate, acutish, 5 to 7 mm. long.



## SPECIMENS EXAMINED:

Mexico. Yucatan: Suitun, *Gaumer 23307*, type collection; *23308*. Campeche: Calakmul, *Lundell 1154*.

A complete description of the staminate and pistillate flowers, based on the Gaumer collections, is given by Blake. The above description is based on the writer's collection of fruiting material.

At Calakmul the shrub was growing on calcareous soil in the *ramon* forest (*ramonal*) covering the ruins. It is a rare species.

## BIGNONIACEÆ

***Adenocalymna standleyanum*** Lundell, nom. nov.

*Adenocalymna heterophyllum* Standl., Field Mus. Nat. Hist., Bot. 8 : 49. 1930; not *A. heterophyllum* Kranzl., Notizbl. Bot. Gart. Berlin 6 : 372. 1915.





FIG. 1—The city of Flores lying on an island at west end of Lake Petén. In background the ancient beach line of Lake Petén can be discerned at base of hills. Water-level of the lake was once about 20 meters higher.



FIG. 2—A street in Flores. Small plant growing between cobblestones is *Euphorbia thymifolia*.



FIG. 1—Grove of *ramon* trees (*Brosimum alicastrum*) covering ruins of Calakmul. This type of climax forest (*ramonal*) covers the ruins of all Maya cities visited in Petén and Campeche. Photographed by S. G. Morley.



FIG. 2—Another view of the *ramonal* covering ruins of Calakmul. Note sculptured monoliths. Photographed by S. G. Morley.



FIG. 1—*Milpa* clearing in upland forest at Santa Teresa on the Subin River. The area had been burned over and planted in corn.



FIG. 2—Another view of same *milpa* clearing a month later. Note young corn plants. Most tree trunks and larger branches remain unburned the first year in *milpas* made in high forest.



FIG. 1—*Milpa* clearing in secondary forest at Santa Teresa on the Subin River. This bush was about six years old when felled. Photographed by L. C. Stuart.



FIG. 2—*Milpa* clearing in secondary forest near San Andres in Northern Petén. Area had been burned over and was ready for planting. Photographed by L. C. Stuart.



House and yard in Yaxha. The fenced plot is an important source of food, supplementing *milpa* crops. In photograph the banana, plantain, *aguacate* (*Persea americana*), coconut, and several species of *Annona* may be discerned. In another part of enclosure grow peppers, tomatoes, other vegetables, and medicinal and ornamental plants.



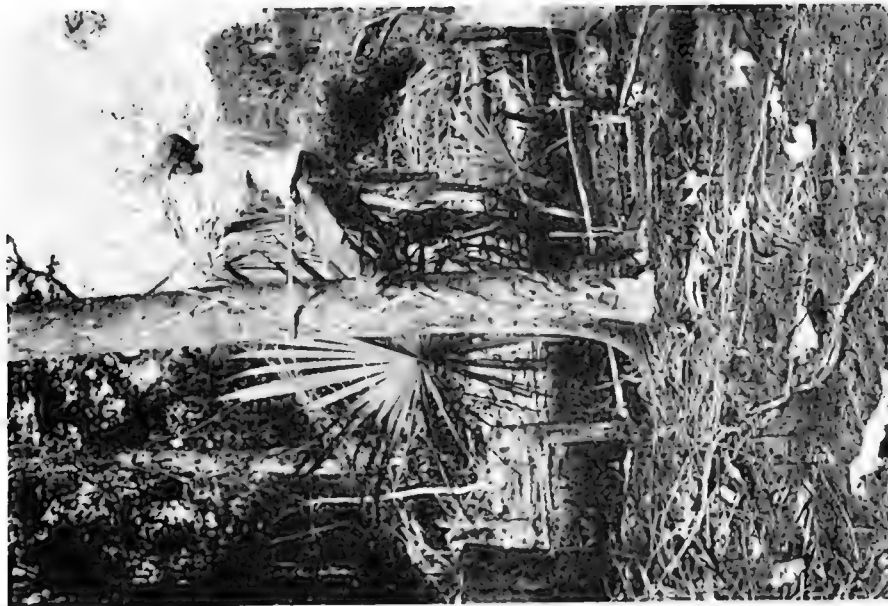


FIG. 1—A *chicle* tapping the *zapote*, *Achras zapota*, for chicle, the basis of chewing gum. The tree dominates the climatic climax forest of Northern Petén. Some individuals reach a diameter of 1 meter and a height of over 40 meters.

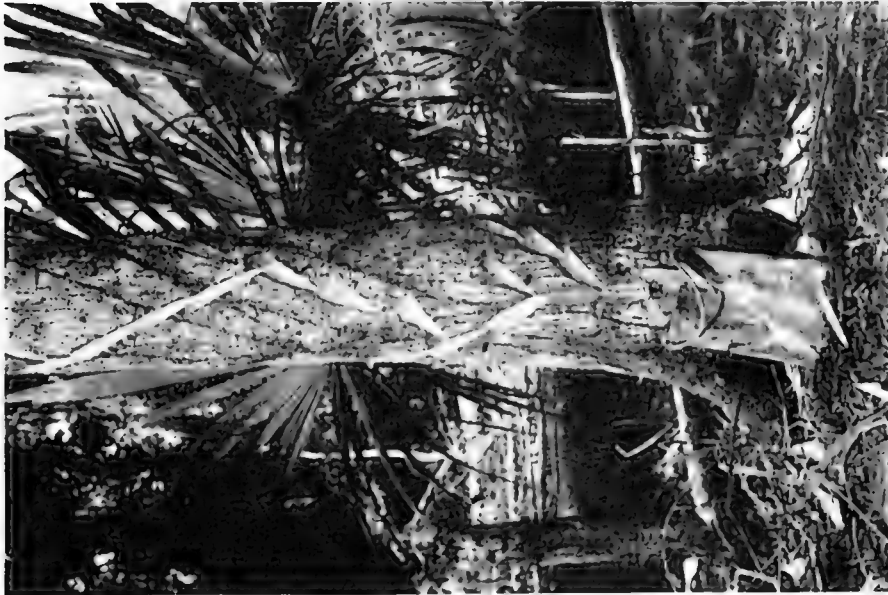


FIG. 2—Close-up view of the method used in tapping *Achras zapota*. Note zigzag oblique series of step-like cuts which form a feather-stitch vertical channel where they meet. The latex drains into canvas bag at base through this channel.



FIG. 1—Lake Zotz. Floating fern and sedge bog. Plant in center with white flowers is *Habenaria pringlei*.



FIG. 2—Lake Zotz. The floating mass along the shore. Tree showing in upper left-hand corner is a *zapotebobo*, *Pachira aquatica*.



FIG. 1—Lake Zotz. Another view of floating mass of vegetation.



FIG. 2—Lake Zotz. The water-lily, *Nymphaea ampla*, called *naab*.

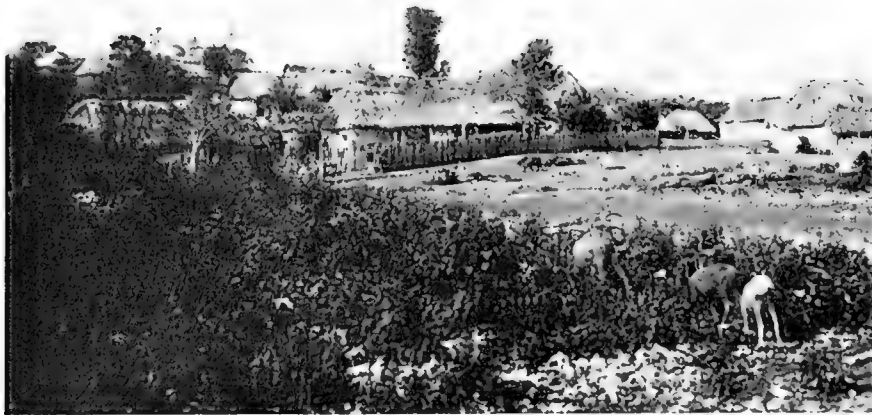


FIG. 1—A section of the village of Yaxha.



FIG. 2—Lake Petén, looking west, from Tayasal. In foreground lies part of settlement on the Tayasal Peninsula. (Note large number of economic plants scattered through the yards.) Village across the lake is San Benito.



FIG. 1—View of Lake Petén near Nictun point, showing the *naabal* association characterized by the *naab*, *Nymphaea ampla*. Other prominent hydrophytes are *Cladium jamaicense* and *Phragmites communis*. Palm growing on the bank is *Acrocomia mexicana*.



FIG. 2—Lake Petén. Another view of the *naabal*. The sedges are *Cyperus articulatus* and *Cladium jamaicense*.



FIG. 1—Wave-swept shore of Lake Petén at Nictun point.



FIG. 2—Sugarcane growing on the bank of Lake Petén.



An *aguada* (*lechugal*) near Uaxactun. The floating aquatic is *Pistia stratiotes* (*lechuga*). The tree around the edges is *Pachira aquatica* (*zapotebobo*). Photographed by O. F. Cook.





Swamp forest (*Spartina*) of the Naachtun bajo. Photographed by S. G. Morley.



Swamp forest (*escobal*) in which thorny *escoba* palm, *Cryosophila argentea*, predominates. Photographed by O. F. Cook.

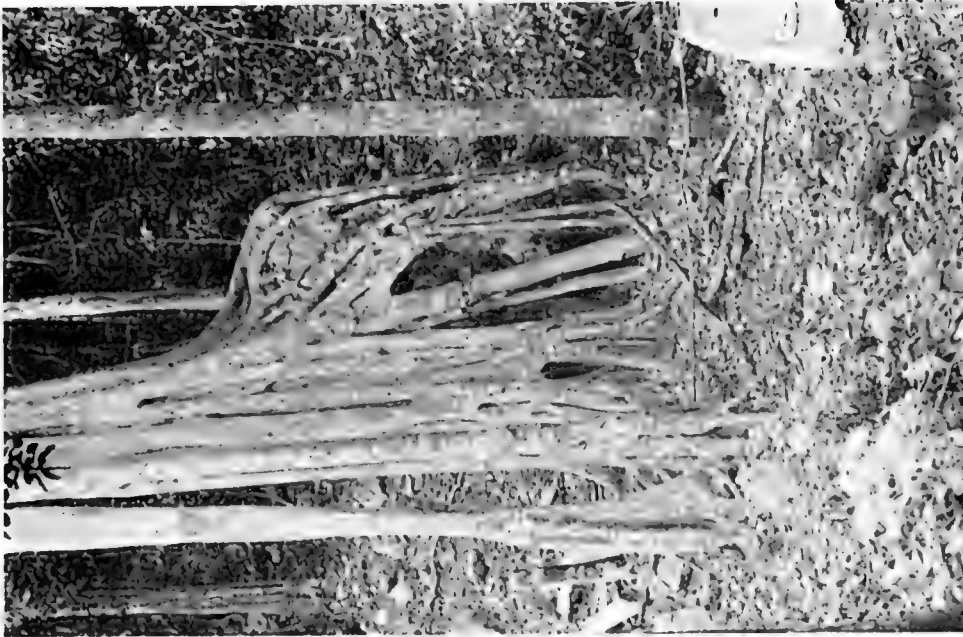


FIG. 2 Species of *Ficus* enclosing a sculptured monument. The strangler-figs begin as hemi-epiphytes, send their roots to the ground, and eventually grow into trees. They cause much destruction to Maya monoliths and buildings. Photographed at Culakmul by S. G. Morley.

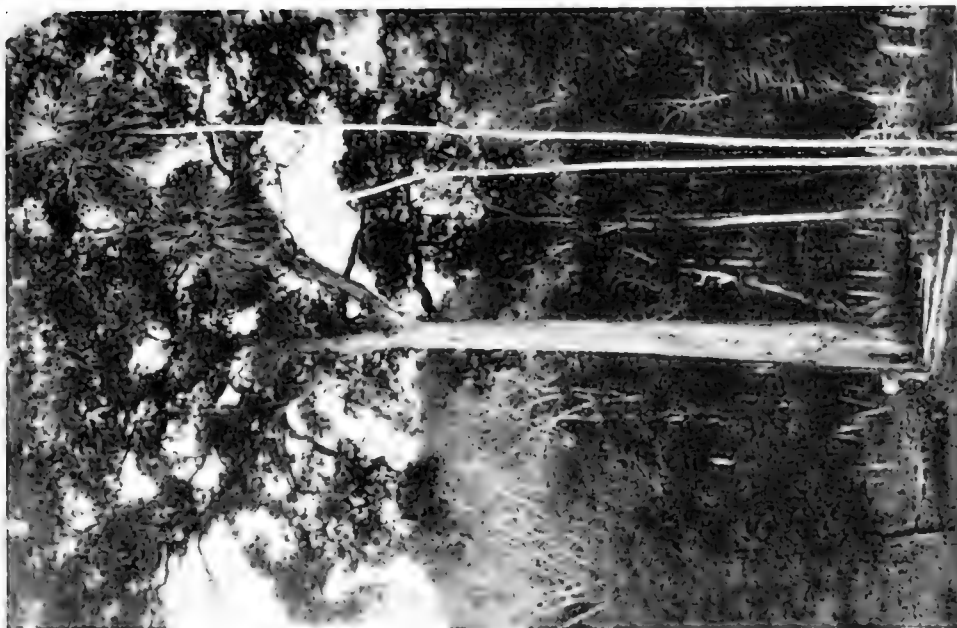


FIG. 1 A giant mahogany tree (*Swietenia macrophylla*) standing at edge of clearing at Uxactun. At right are two *botan* palms (*Sabal* sp.). Photographed by H. H. Bartlett.



The forest of Northern Petén. Species of *Sabal* and *Ficus* in foreground. Photographed near Uaxactun by O. F. Cook.





FIG. 1—Section of Sabana Zis, showing scrubby semi-deciduous marginal forest.



FIG. 2—Sabana Tzimintun. Photograph was taken a few days after fire had swept the area. Stone foundation is reputed to be remains of structure in which an image of the horse of Cortes was hewn.



Sabana Kantetul. The xerophytic marginal vegetation has overrun greater part of the savanna.  
This is the first stage in transition from grassland to mesophytic forest.



FIG. 1—The black fire-swept grassland. Within a few days after the first rains, the perennial herbs sprout out and begin to flower, changing charred countryside into a garden.



FIG. 2—Fire sweeping through marginal forest. Photographed by L. C. Stuart.





FIG. 1—A hill with much of the forest killed by fire.



FIG. 2—A denuded hill.



The savanna northwest of La Libertad. Such low ranges of forested limestone hills separate broad expanses of grasslands.



FIG. 1—Sabana Kaltó.



FIG. 2—Sabana Kaltó. Note broad expanses of flatlands, and numerous "wooded islands" (*zukches*) which mark locations of sinkholes.



FIG. 1—A grove of the *saha* tree, *Curatella americana*.



FIG. 2—Scattered individuals of *Byrsonima crassifolia*, the *nanze* tree. The *saha* and *nanze* are typical small gnarled, fire-resistant savanna trees. Note that fires have burned off all the herbaceous vegetation.



FIG. 1—A "wooded island" in Sabana Kaltó. Tree on left with white trunk and large leaves is *Miconia argentea*; tree on right is *Bursera simaruba*.



FIG. 2—A drained sinkhole (*zukche*) in Sabana Kaltó. The palm is *Acrocomia mexicana*. Photographed by L. C. Stuart.



FIG. 2—*Crescentia cujete*. The globose fruits are dried and made into useful vessels such as cups, bowls, and dippers.



FIG. 1—*Crescentia cujete*, the calabaza tree.





Swampy grassland (*bobolar*) in Sabana Zotz. *Hymenocallis littoralis* is the attractive plant in the foreground.





FIG. 1—Street in La Libertad. Note thatched huts and yards enclosed by pole fences. The two medium-sized trees in foreground are *Chrysophyllum cainito* and *Talisia oliviformis*, both planted for fruit. The palm is *Cocos nucifera*, the coconut.



FIG. 2—View of the plaza of La Libertad. A total of 243 species of cultivated, semi-cultivated, adventive, and native plants were collected within the confines of the village. Large tree with partially defoliated crown is *Lucuma hypoglauca*, planted for shade and fruit.



FIG. 1—Sabana Kaltó.



FIG. 2—A small “wooded island” (*zukche*) surrounding a drained sinkhole. A total of 59 species of ferns and phanerogams were found here. Tall slender tree with an umbrella-like crown is *Xylopia frutescens*.



FIG. 1—Aguada Chachacluum. This shallow sinkhole dried out in 1933, and its basin was overrun by herbs of which *Eragrostis hypnoides* was most prominent. In the background the nature of the *aguada* bank vegetation is evident. The low shrubby belt at the edge is followed inland by a tree belt which intergrades into the flatland high forest.



FIG. 2—Aguada Polol, a large basin in the open savanna. Polol, the ancient Maya ceremonial center, lies hidden in the forest in the background.



*Asiatic Yucca* in Monte Chicbul. This shallow undrained sinkhole retained water through the dry season of 1933. Continual disturbances by cattle prevent the growth of aquatic vegetation. The bush in the background is marginal forest bordering the savanna.



Flatland forest surrounding Aguada Chachacuum. Forest vegetation is slowly invading the grasslands in spite of fire conditions and severe dry seasons. Note abruptness of change from grassland to forest. The tall white trees in the center with few branches are *Didymopanax morototoni*.



Marginal forest surrounding a drained sinkhole in the flatlands. Note thorny, scrubby, semi-deciduous xerophytic vegetation. The giant terrestrial monocotyledon in center is *Bromelia karatas*. Among other species are the *sapa* palm, *Acrocomia mexicana*, a bullhorn *Acacia*, and two lianas, *Davilla kunthii* and *Tetracera volubilis*.





The savanna near Chiche. Note the densely forested limestone hill in the background.



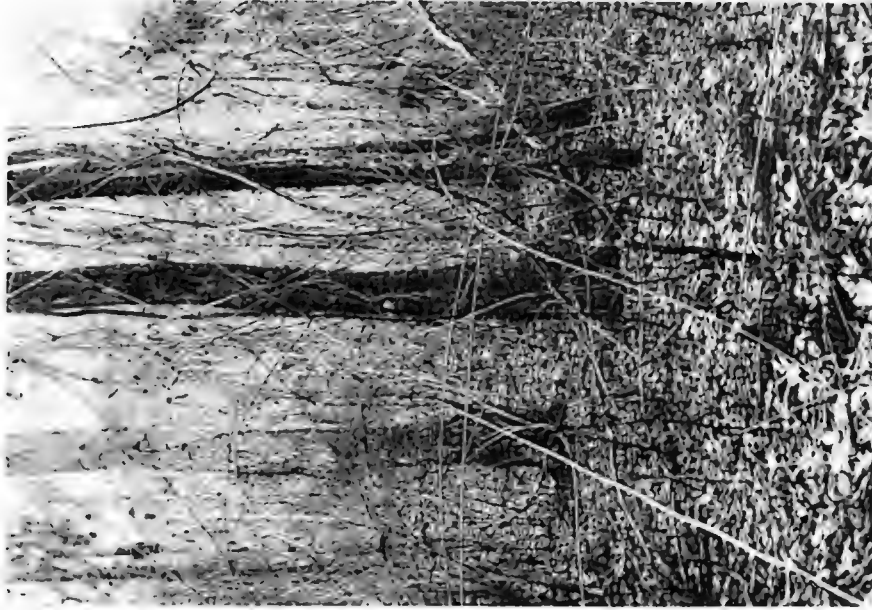
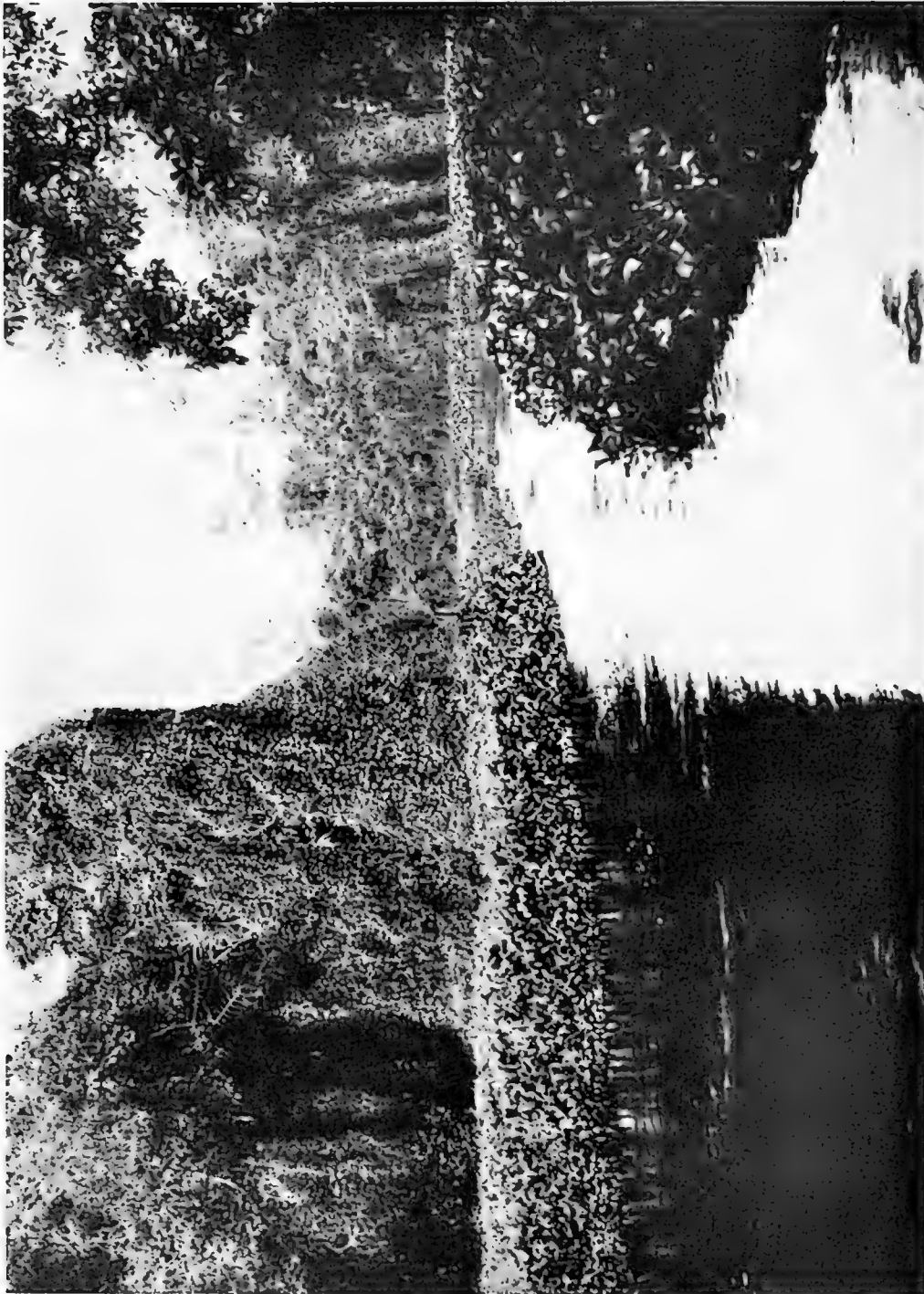


FIG. 2.—A section of the limestone valley forest of Monte Hilton showing fire destruction. Many of the trees burned to hollow shells and collapsed.



FIG. 1.—The limestone valley forest in Monte Hilton. The giant tree is *Enterolobium cyclocarpum*, and the thorny slender palm is the *escoba*, *Cryosophila argentea*. Fire had swept through the area and cleared out practically all the underwood.



The Subin River near Santa Teresa. The floating hydrophyte, *Eichhornia crassipes*, almost blocks the stream. Vine which completely covers the river bank trees is *Vigna repens*.



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